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The Registered Office and Laboratories of the B.C.I.R.A. at:—
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Telephone: Central 1885. *Telegrams: CIRA*
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Foundry Technical Institute, Meek's Road, Falkirk (*Telephone* 332)

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Welded Structures

Some aspects of welding and cutting described in a recent Paper by George R. Buchanan (before the West of Scotland Branch of the Association of Mining Electrical Engineers) are worthy of bringing to the notice of the foundry industry. With reference to the use of oxy-coal-gas cutting machines, it is stated that "the disposal of scrap is a problem which arises out of the use of cutting machines. In one large establishment, where two cutting machines are employed, a man has been selected to see that useful pieces of scrap are set aside and used. This has resulted in a considerable saving, but there still remains 15 per cent. to 20 per cent. of scrap which cannot be used, at any rate, in this particular firm's products." This statement draws attention to an aspect of considerable importance which is very often overlooked in considering the economics of welded structures. The raw material of welded- or fabricated-steel structures is principally standard bars, sheets, angles, tees, and in the absence of special supply arrangements, there must be numerous instances where the standard commercial sizes of such semi-finished products leave a substantial wastage in cutting up. This wastage ultimately finds its way to the scrap merchant, and the fact that it is of quite a substantial magnitude is visible clearly in many of the scrap stocks in various yards throughout the country. The importance of the matter is realised evidently by Mr. Buchanan, for in the same Paper he makes the suggestion that "it might be feasible for a number of firms to club together and use each other's scrap."

Obviously, this wastage can be regarded from a number of different standpoints. The foundry trade naturally will be more inclined to consider its incidence in the economics of fabricated structures as against castings. It is probably true to say that a carefully-controlled wastage of the order of 15 to 20 per cent. in the oxy-coal-gas cutting is at least equal in magnitude to that incurred in numerous cases of the manufacture and utilisation of castings. It is not clear, and it surely ought to be, whether such wastages are taken into consideration in the various comparisons made of the costs and weights of fabricated structures and castings (one wonders whether this has been done in the comparative figures quoted by Mr. Buchanan). Whatever standpoint is taken, it must be evident that wastage of such a high order must exert quite a substantial influence in the production costs of fabricated structures, and any such handicap cannot fail to be appreciated by foundrymen striving to adapt the metallurgical and mechanical improvements in the production of castings better able to resist this competition.

Castings for the Chemical Industry

Castings for the chemical industry form a most important section of the foundry business. In recent years chemical engineering, the design and construction of plant for large-scale chemical operations, has become a branch of the profession of considerable size, having its own technical groups. At an exhibition recently held in Germany of the chemical industry, some exhibits of great interest to metallurgists were shown among the several hundred stands. Chemical engineers are, of course, interested in the purely mechanical properties of materials of construction, like other engineers, but they have a special concern with the effects of corrosion, erosion, and temperature, and with the effects of temperature on mechanical properties. The number of stands devoted to refractory materials showed some of the limitations of ferrous materials against heat, while in other directions enamel coatings and gum or rubber coatings were used protectively on a metal or other base. The stand of Krupp was the most representative metallurgical display, special attention being given to the high-chromium (12 to 18 per cent.) steels, the austenitic steels of the 18 per cent. chromium and 8 per cent. nickel type, with or without other alloy additions. Corrosion-resisting castings of the 1 to 2 per cent. carbon and over 24 per cent. chromium were also shown, as were heat-resisting cast irons and high-silicon castings of 14 to 18 per cent. silicon. Progress seems to have been made in the production of sound castings in this last-mentioned type of corrosion-resisting iron, shown or used on a number of stands, and the opinion was expressed that the acid-resisting steel developments of recent years have not really damaged the market for this admittedly more fragile material. Other Krupp displays referred to nitrogen hardening and to the well-known widia type of cutting material. Apart from other stands relating to ferrous materials of special corrosion-resisting or heat-resisting properties, a most striking feature was the space devoted to welding, welded structures and the manufacture of industrial gases for these processes. Finally, it was interesting to note that, as far as could be ascertained, there were no foreign exhibitors.

Oil-Engine Castings

At a recent meeting of the East Midlands Branch of the Institute of British Foundrymen, Mr. H. E. Beardshaw repeated his Paper* on "Oil-Engine Castings." Mr. P. A. Russell presided. The discussion, an abstract of which is presented below, was opened by Mr. T. Goodwin, who said the author had mentioned that he used nothing but refined irons. He could not quite see that point; what were refined irons and what were de-gassified irons? With all the system of control mentioned by the author there had been no mention of casting temperature, and he (Mr. Goodwin) could not see what was the use of the control of runner sizes, etc., unless the temperature of pouring was guaranteed. As to the cylinder heads illustrated, there were many similar castings made locally, and the pencil runners proved satisfactory for that type of casting. Regarding the chills, he did not know why they should be vented.

Refined Irons

Mr. Beardshaw, in reply, said he had used the term refined irons because that was the name given to them by the manufacturers of that class of iron. He might just as well have called them "A" irons or "B" irons. He was not prepared to say what "refined irons" were. They were irons that were not run from the blast furnace, and, as such, were not liable to the variations that one does get from that source. He did not hold any brief for the degassified process. They were simply stirred, etc., but the metal is thoroughly well mixed and the first batch was of the same composition as the final tapping. They were not cheap irons, but by virtue of their consistency they were used to prevent waste. As to pouring temperature, he had had several types of optical pyrometers offered to him, but he did not think there was a satisfactory instrument. He had experience of measuring by the immersion type, which he thought to be the only satisfactory method. If the cupola control had been good and had been of the same order from day to day, there would be very little variation in temperatures. If one made certain the metal was very hot, one could be sure of good results. One could not pour the castings too hot. It was a matter of standardisation of conditions from day to day. The whole point was the success or otherwise of the vents in the chills and standardising. His experience was that chills without vents produced bad castings, whilst with vents the castings were good.

Life of Chills

Mr. Hillman asked what was the number of times a chill could be used?

Mr. Beardshaw replied that, after using a chill for ten or twelve times, there would be trouble, and so they were then scrapped.

Mr. Measures instanced a case where a chill used the first time produced a blow, but afterwards it was satisfactory. Could the author throw any light on that point?

Mr. Beardshaw asked whether the chills were warmed, and, receiving a reply to the contrary, said it was their practice to warm all chills before placing in the mould to prevent the formation of blowholes from dampness on the chill. He could not give any definite reason why the chill should blow the first time and not the second. He had no experience of chills so heavy as those under discussion.

Mr. Pycroft asked whether the author had any data on the relationship between the thickness of the chills used and the depth of chill required in the castings. Referring to the author's data on runner sizes, he thought that the pencil type of runner would allow faster running than the ingate type, although of the same area. When running from the top, did the author use a plug in the runner bush? He could not see how the bush could be filled from the ladle without stopping, for there was always the risk of trouble due to "shot" or pebbles of metal going into the mould.

Mr. Beardshaw said that, if he had referred to "chills," he should have said "denseners." By a chill he would mean something that would induce a white structure or a mottled structure, but a densener would leave a fine graphitic structure. The size of the densener must be of a certain dimension to give a certain result.

Mr. Pycroft said in his experience he had found that to give a certain depth of chill to a casting there must be the "chill" thickness four times that of the section to be chilled. That is to chill a casting to a depth of $\frac{1}{8}$ in. the iron chill casting would be $\frac{1}{2}$ in. thick. Had the author any similar data on his experience?

Mr. Beardshaw said he must definitely disagree with any law so enunciated. Conditions in every case varied, and it was impossible for anyone to say what thickness of chill would be required. It must be from experience on each particular job.

Mr. Orme said one must have a starting point, and he agreed with Mr. Pycroft that a definite thickness would give a definite chill. If thickness of the casting increased so must the chill-thickness be increased.

Mr. Beardshaw pointed out an obvious discrepancy, as the speaker admitted that one must alter according to the varying conditions of casting. Replying to Mr. Pycroft as to the use of plugs in runner boxes, he said that in some cases he had no plugs. The bush was placed over a series of pencil runners and the metal poured rapidly from the ladle into the bush so as to fill up the bush immediately.

Mr. Measures said he had noticed one type of casting that was made face downwards, where the runners were in the bottom of the mould connected to a spray runner in the bottom of the mould. Would it not have been better to have the in-runners in the bottom half of the mould connected to a spray runner in the top half?

Mr. Beardshaw said the illustration was one of the old types. In the modern types all castings were run in a low carbon iron and were run on the top.

Mr. Armitage asked whether there were any risers on the flywheels?

Mr. Beardshaw said that no risers were used. The castings were run on the edges of the flange with two downgates in one bush.

Mr. P. A. Russell said he was sorry that the discussion had ranged around chills. That was, to his mind, a subsidiary part of the Paper, the main idea being to show the necessity of complete control of the processes of manufacture.

Vote of Thanks

Mr. Peace proposed a vote of thanks, and said the author had brought along quite a number of novelties, in particular the vented chills and the systemised scheme of runner sizes. That question of running must be governed by laws that were not properly understood.

Mr. Bigg seconded, and the vote was received with acclamation.

* Foundry Trade Journal, December 29, 1932, *et seq.*

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Production Costs and Selling Prices

To the Editor of The Foundry Trade Journal.

Sir,—In my letter last week giving costs of labour, a clerical error was made and rates given should read "per cwt." and not "*per ton*."—Yours, etc.,

Jobbing Founder.

May 25, 1934.

Random Shots

One fine day last week "Marksman" decided that the question of fresh air in the foundry had not hitherto received the attention it deserved. So he caught an early train to Eastbourne and called upon Miss Nellie Snookers, who has been carrying out experiments in connection with ventilation and so forth in the Gayway Foundry. "Is it not a fact," said "Marksman" to Miss Snookers over a——well, over the desk, so to speak—"that fresh air is really an essential in the foundry? Foundry owners are well aware that this is so, but there are difficulties. I thought, Miss Snookers, that you, with your experience in these matters, might have some inspired message, some plum from the hard tree of experience, for my readers. . . ."

* * *

At once Miss Snookers divined what was required of her. "When we began to study the question of fresh air in the foundry," she said, "we found it was not at all a simple problem. There were two distinct problems, in fact; firstly, ventilation, and secondly, air conditioning. Ventilation is when you put fresh air in or take stale air out, and air conditioning is when you try to keep fresh air fresh or stale air from getting staler." "Isn't that somewhat too technical for the ordinary foundryman to understand thoroughly?" asked "Marksman." "But in matters like ventilation you can't help being technical," was her reply. After that, conversation became still more technical, and perhaps it would be best if "Marksman" were just to describe what has actually been done in the Gayway Foundry to keep the air fresh and (when the knock-out isn't working) clean.

* * *

In the summertime the arrangements and apparatus are as follow: A spare cupola has been adapted to supply the foundry with cool, clean air. The shaft has been blocked completely at a point a few inches above the charging door, which is practically an air-tight fit. The tap hole is also permanently bolted up. About 20 ft. from floor level a series of $\frac{1}{2}$ in. diam. holes has been made around the cupola. A special air duct leads underground from the cupola blower to a filter-fitted air intake situated about a half-mile away at the end of Eastbourne pier. Ice is charged into the cupola, the charging door is closed and the blower is started up. Fresh ozone travels from the air intake at the end of the pier to the blower in a space of 10 minutes. It then passes through the ice charge, is forced up to the top of the shaft and escapes through the ring of holes described above. This air, which is much cooler than the air already in the foundry, sinks down to the moulding floor, and thus the workmen are provided with a continuous supply of cool, fresh ozone, even in the middle of an August heat wave when pouring is in progress. The consumption of ice, incidentally, is 2 tons a day. Only once has the arrangement temporarily failed, and that was when a sea-gull built a nest in the ozone intake.

* * *

Miss Nellie Snookers also described the apparatus which is used in the winter time. "Marksman" proposes to describe this on another occasion. He is rather vague about the exact details of it. While Miss Snookers was describing it, the atmosphere around the "air cupola" became so stuffy that he pleaded urgent business to escape, and went for a promenade on the pier—right out to the "ozone intake!"

Marksman.

Mr. Brynmor Jones, a member of the teaching staff of Cardiff University College (Department of Metallurgy), has been awarded the Carnegie Gold Medal for his work on the hardening of steel by means of nitrogen.

Steel Castings with Special Reference to the Tropenas Process*

By J. E. Mercer and D. K. Barclay

In giving these few notes on steel-foundry practice, it is, of course, realised that only the fringe of the subject can be touched. The steel-foundry industry, we think, commenced on a commercial basis round about the year 1860. It is thought that Vickers and Hadfields were two of the first firms to commence manufacture. Vickers built the steel foundry at their River Don Works about the years 1868-1870, their chief manufacture being propeller blades and bosses, railway crossings and points, and bells. In the early stages clay crucibles were used as melting units, with coke as a heating agent. A battery of these crucible fires would hold, perhaps, two crucible pots each, the amount per pot probably not exceeding 120 lbs.

Considerable skill and ingenuity would be required to make some of the larger castings in these early days, and there is no doubt these early steel founders produced a good steel. The steel melted in the crucible would, of course, be largely free from any oxidising atmosphere and the pick up of silicon from the clay pot would help to keep the steel "dead." It would also have plenty of "body" and be fluid at comparatively low temperature. Consequently, the amount of shrinkage during solidification would be small compared with present-day steels made by modern methods such as the open-hearth, electric and Tropenas.

This Paper is to have special reference to the Tropenas process of steelmaking, and initially it is well to mention that several types of converter have been evolved from the original converter designed by Sir Henry Bessemer. The basic principle in all is similar—the application of blast to cupola-melted metal. The blast is either impinged on the surface of the metal bath, as in side-blown converters, or through the bath from the bottom.

Fig. 2.—Baby Bessemer in Blowing Position.

The Baby Bessemer

The production of steel by the Tropenas Converter necessitates the use of two melting units—cupola and converter. As this Paper is dealing principally with the steel side of the process, it is proposed to confine comment on the cupola to the preparation of liquid charges to the converter.

By its flexibility and ease of control, the converter offers to the steelfounder a convenient and economical method for the supply of excellent steel for the production of light and medium steel castings. With reference to design, the body of the converter is cylindrical in shape with a conical concentric nose. It is lined with acid material, mounted on trunnions, and carried on side frames. The mechanical arrangements allow of the furnace being moved to the desired position. Fig. 1 shows a sectional elevation and plan of the converter.

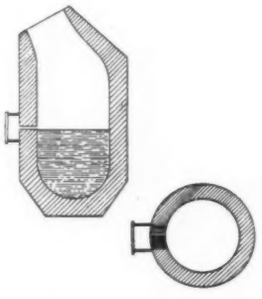


Fig. 1.—Section and Plan through Tuyeres of a Tropenas Converter.

It may be mentioned that, originally, the Tropenas converter, patented in 1891, had a secondary set of tuyeres, placed at a higher level. These were brought into use during the combustion of carbon-monoxide to carbon-dioxide. Tropenas claimed that by the supply of this secondary air complete combustion of the carbon-monoxide was obtained and additional heat was imparted to the bath. As the converter is lined with acid material, obviously no reduction of the impurities—sulphur and phosphorus—takes place, but rather an increase of sulphur from the cupola coke usually amounting to about 0.03 per cent. Some slight increase of phosphorus may be expected from the bath concentration.

Notwithstanding the fact that it is now possible to desulphurise the cupola-melted metal up to about 40 per cent., it is necessary carefully to control the quality of hematite, steel scrap and coke going to the cupola.

In calculating the cupola charges, a start may be made with an admixture of hematite and steel scrap which will give a silicon content of 1.7 per cent. in the liquid iron. The hematite used should contain from 3 to 3.5 per cent. silicon, with sulphur and phosphorus as low as possible.

As the cupola and converter warm up from successive heats, the silicon content of the liquid iron going to the converter may be systematically reduced by lowering the hematite portion of the cupola charge to give about 0.8 per cent. in the iron. The melting practice in the cupola proceeds in the usual manner common to the iron foundry. The regulation of the blast is under the direction of an attendant, who controls the melt according to the requirements of the converter. The liquid iron is transferred to the converter, which is then set back until the metal just tips the botton of the tuyeres. Fig. 2 shows the converter in position to start the blow.

Chemical Researches

Blast is admitted through the tuyeres at about 3 lbs. per sq. in. At the commencement some iron is oxidised to ferrous oxide, and if the temperature of the iron has been correct, the vessel soon "lights up." The order of oxidation of the elements will be, silicon, manganese and carbon, with some oxidation of iron to ferrous oxide. If the iron has been hot, the elimination of the silicon will be complete before the carbon is attacked, but if the iron is excessively hot, the relative affinities for oxygen of silicon and carbon are reversed and most of the carbon will be burnt off before the silicon is seriously attacked.

As the silicon, manganese and carbon contents in their reaction with oxygen impart a considerable amount of additional calories to the bath; their combustion throughout the blow must be carefully regulated, as the generation of excessive temperatures means increased oxidation of iron to ferrous oxide, and whilst it is true that a portion of this oxide passes to the slag, a great deal remains in solution (Fig. 3).

The oxidation of silicon is recognisable in the violent eruption known as the boil which takes place within the vessel. At this period the blast pressure should be considerably reduced to check the amount of throw-out and keep the temperature within reasonable limits.

The reaction is $Si + O_2 = SiO_2$. The manganese is also eliminated about this period as $Mn + O = MnO$. On completion of the oxidation of silicon and manganese, the blow enters its final stage and the carbon flame soon appears, easily recognisable by its length, luminosity and feathery edges (Fig. 4).

The oxygen combines with the carbon, forming carbon-monoxide which burns to carbon-dioxide at the mouth of the vessel. As the carbon burns off, the flame diminishes in size and finally just overtips the mouth of the furnace, denoting the end of the blow. The vessel is turned down and the bath ready for deoxidation. The following analysis of the slag previous to the addition of deoxidisers may be of interest: Silica, 62.10 per cent.; iron oxide, 26.62; alumina, 1.21; manganese oxide, 9.71; calcium oxide, 0.40 per cent., and magnesia, trace.

Fig. 3.—Showing the Vessel during the Removal of the Silicon.

Taking into consideration the nature of the process, it is to be expected that converter steels at this period contain a higher ferrous oxide and gas content than other steels.

* A Paper read before the Middlesbrough Branch of the Institute of British Foundrymen.

Consequently, quality can only be obtained by care in the selection of deoxidisers and the method of their use. Deoxidisers are various and include ferro-alloys of silicon, manganese and titanium; also aluminium and calcium, or combinations of two or more of the foregoing. They may be added to the bath in solid or liquid

Fig. 4.—View of the Tropenas Plant showing the "Carbon" Flame.

form. Converter steel may be carburised to any extent with liquid iron from the cupola.

Time should be given for the deoxidisers to function, and also for the products of reaction, usually in the form of oxides, to pass to the slag. A certain amount of superheat at this period is an advantage, as by holding the steel in the furnace the elimination of insolubles is encouraged. Fig. 5 shows the converter ready for tilting the steel into the ladle.

Foundries using the converter may undertake the manufacture of castings which exceed the capacity of the furnace, as it is possible to hold a heat in the ladle while subsequent charges are being "blown" to add to it.

Little fault can be found with the liquid steel in the foundry, its high fluidity being an advantage in foundries making intricate castings, and a large amount of small work. Generally speaking, steel should be poured at as low a temperature as is consistent with obtaining a good impression of the mould. The improvement in sulphur content now possible by desulphurising the liquid iron from the cupola has, to a very large extent, mitigated the tendency of converter steel to "hot tears." With present-day practice there is no difficulty in meeting any steel-casting specification from a sulphur and phosphorus point of view.

Relative Life of Electric Converter Steel

No Paper on the steel foundry would be complete without some mention of the respective fluidities of converter, electric and open-hearth steels. The authors, having daily experience of converter and electric steels, have no hesitation in saying that converter steel does "hold up" better in the ladle. Various reasons have been advanced to explain this superior fluidity. These include incomplete reactions from finishing alloys, the presence of dissolved oxides and high-temperature conditions. The assertions relating to reactions from finishing alloys and high-temperature conditions may be disregarded, as both are controllable in the furnace. With regard to dissolved ferrous oxide, it has to be admitted that converter steel is not comparable with electric or open-hearth in this respect. However, if care has been taken in deoxidation, and in view of the fact that ferrous oxide has a limited solubility governed by temperature, it is questionable whether converter steel suffers to the extent supposed. As a matter of fact, experience shows steel high in oxides to be low in fluidity.

A Paper by the American metallurgists, C. E. Sims and G. A. Lilliequist, on "Inclusions—Their Effect, Solubility and Control in Cast Steel," gives much valuable information on the subject, and it may be permissible to mention the following from their summary:—

(1) If the iron oxide content of the steel is high, the inclusions will precipitate at the beginning of the solidification and will exist as globules of silicates and sulphides and the steel will have good ductility.

(2) If the iron oxide content of the steel is too low, the solubility of the sulphides is increased to such an extent that they precipitate as a eutectic with the last steel to freeze. The ductility of such steel will be low.

Freezing or Solidification of Steel

The freezing of steel causes shrinkage of volume with subsequent contraction of the casting. The avoiding of defects at this time is, perhaps, the greatest problem with which the founder has to contend. During freezing and solidification the aim should be to have a greater thickness or diameter of steel in the feeding head than in the thickest sections of the casting. The object of this is to allow for the solidification of the casting while the head still contains liquid steel.

In casting ingots, a comparatively cold iron mould is used with a refractory or hot top. The sides of the mould convey the heat away from the steel and the hot top keeps the steel liquid for a greater length of time at the top of the ingot, for feeding purposes. Even so, it is necessary to discard 33⅓ per cent. of the ingot before forging. This gives some idea of the difficulties with which the steelfounder has to contend, in heavy sections made in sand moulds of low heat conductivity. To delay the freezing of the feeding-head surface exposed to the atmosphere, and to obtain from it full feeding value to the casting, various methods have been tried, such as hot powdered slag, finely-broken coke, electrical apparatus, and many proprietary compounds on the market for the purpose. Even with every assistance from the above, and with as much as a 40 per cent. head, shinkage cavities have still a disconcerting way of appearing.

A further handicap in this respect is encountered where thin sections (which must be cast to shape) adjoin heavy sections. Hot steel must be used to make quite certain of running the thin sections and thus greater care taken in feeding. In heavy circular castings it is of advantage to have a full head running round the casting wherever possible. If the moulding tackle available precludes this, then the edges of the several heads should be gradually tapered to meet the casting. If the head is taken straight down to the casting, there is a great risk of "hot strains" running into the casting from the outside edge of the feeding head. Every steelfounder will have encountered this trouble on the bosses of wheels. These strains often only make their appearance after the machining of the centre hole.

With very large heads, it is the practice, after a quantity of slagging material has been put on, to keep the surface of the feeding head disturbed. This allows of the head being kept open for subsequent fresh metal from the ladle.

Contraction strains occur between thick and thin sections of a casting, as, for example, a 6-in. boss with four ¾-in. ribs joining up. It is almost certain that, unless precautions are taken, there will be a drawn hole in the rib where it joins the boss. Round chills placed at each corner will counteract the trouble, and also prevent the rib pulling during contraction. The custom of putting brackets between thick and thin sections is still very necessary on some castings, but there are numerous castings where these are quite unnecessary and where outside chilling is to be preferred.

Chills

Generally speaking, a chill should be made so that there is no sharp line of demarcation between the chill and the unchilled portion of the casting. The chill should be gradually tapered off to its extreme edge and the chilling effect merged into the unchilled portion of the casting, thus obviating a tear or pull where the chill ends. Another method of chilling heavy sections is the insertion of internal chills. This method is recommended when the chills can be inserted in bosses which are subsequently drilled, the chills being removed in the machining. The use of internal chills is not recommended at the junction of ribs, etc., as they are a source of weakness in the casting.

Fig. 5.—Turning the Steel into the Ladle.

Contraction Allowances

The amount of contraction to allow on any given steel casting is a problem often encountered. The same allowance for one foundry will not serve for another steel foundry. The reason, of course, is not that the difference is in the contraction of the various steels, but lies mainly in the difference in the foundry procedure. For instance, a large quadrant made in a certain steel foundry was made to cast-iron contraction

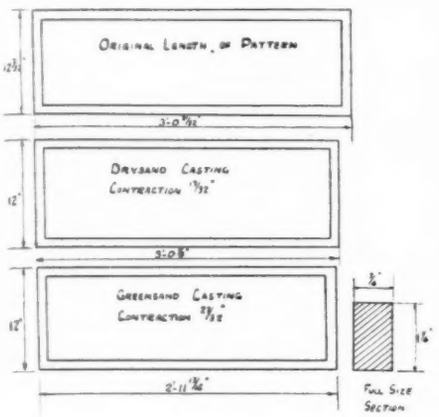


Fig. 6.—Tests for the Contraction of Steel.

rule—1 in 120. The same pattern sent to another foundry required 1 in 60, because in the second foundry mentioned free movement was allowed for as soon as contraction commenced.

A simple illustration of the difference which can occur is shown in Fig. 6, which gives by the dimensions and sections the exact size of the casting. At the top is shown the size of the pattern, which weighs 23½ lbs. Immediately underneath there is a casting made from the pattern made in the ordinary sand of the shop and dried. The contraction in this case is $\frac{17}{32}$, or approximately 1 in 68. The bottom casting is made in green sand and has contracted $\frac{37}{32}$, or 1 in 43. The question may be asked "how many tears or pulls were there in the one-cast dry

Fig. 7.—0.15 Carbon Steel, as Cast. ×100.

sand?" Actually there was none. The reasons are that in the dry-sand mould, the warm mould prolongs the period of cooling. Again, the centre of the mould being dry, offers a certain amount of resistance to the free movement of the steel during the period of contraction. Also, although the down runners and risers were immediately freed, a certain amount of resistance would be set up there. In the case of the green-sand mould, this being cold, the steel would be frozen quickly and the resistance of the mould, runners and risers would be almost negligible.

In dealing with bedplates 6 ft. long and $\frac{7}{16}$ in. thickness, and other castings $\frac{3}{8}$ in. thickness of various shapes and designs, it can readily be understood what a large part the degree of collapsibility of the core, the freedom of movement of runners and risers, and the temperature of the mould, all play in the production of castings which must be cast true to size and to very fine limits. Thus, by the foregoing, it will be seen how important it is, first, to have rigid control of the mixing of core sand and oil in correct proportions so that regularity is obtained from day to day. Secondly, when the moulder is ramming up his runners and heads, how necessary it is to have collapsible material round these. Thirdly, to make a good joint round the mould so that there is no flash or fash on the box edges, which incidentally can cause a lot of trouble in holding the casting and thus causing tears. Lastly, to have the mould absolutely free from moisture.

Design, too, plays a large part in the contraction allowance. As near as possible, castings should be regular in thickness throughout, compatible with the casting fulfilling the duty alloted to it. Gradual curves should also be included instead of sharp corners and angles. How often does one see heavy sections adjoining on to thin sections, whereas a reduction in weight of the heavy section would materially strengthen the casting as a whole by eliminating the solidification strains otherwise induced? A type of casting recently made for the Admiralty which in general thickness was only $\frac{3}{8}$ in., but about 4 ft. long and 2 ft. 9 in. deep, could very well be set up as a model in designing on the lines of least resistance to contraction.

In considering gear wheels, a policy invariably followed out years ago by one steelfoundry manager was to have an uneven number of arms connecting the boss to the outer rim. This certainly relieves the contraction strain, as in a wheel with an even number of arms there is a direct pull across the wheel which in a large gear wheel causes unevenness in the periphery due to the arms pulling in the rim. A recently-published Press protograph of a 27-ton gear wheel showed that the designers in this instance had realised the value of an odd number of arms. In further reference to gear wheels, a wheel with a comparatively thin plate connecting the rim to the boss will have a great amount of contraction. The thinner the plate the greater the contraction. A gear ring of the same rim section will have a much less contraction. It may be assumed then, that by keeping the general foundry procedure the same, and with rigid control in the core-sand department to ensure the same quality from day to day, it is possible to tabulate a reasonable list of contraction allowances. As a matter of fact, most foundries work to special contraction rules for various types of castings. For general engineering castings, however, the engineer is safe in instructing the patternmaker to work to the 1-60 standard steel-contraction rule.

Sand and Compos used in the Fonndry

Sand and bonding material have been reviewed at great length, moisture content and permeability gone into thoroughly. There is no doubt that steelfoundry practice has benefited greatly by these investigations, and as a result, with rigid technical control in the preparation and handling of sands, wasters are at a minimum.

Reviewing the sand used in the Sheffield district about 40 or 50 years ago, these pioneers of the steel-castings industry had to find a material sufficiently refractory to make moulds. Evidently they were struck with the heat-resisting qualities of firebricks and used these as a basis for their moulding composition. The next obvious material was the clay pots in which they had melted their steel. (There was always an abundance of clay crucible pots as a pot only lasted three heats, or one day's melting.) A clay crucible pot breaks up on becoming cold. Great care was taken to remove carefully all slag and other unwanted material from the broken pots and bricks. One steelfoundry in Sheffield used two compositions—brown and black compo. Brown compo was used for castings weighing up to 70 tons, at a later period. Brown compo was mixed in the following manner:—Nine parts of old firebricks, one part clean small coke, one part German blue clay. This clay was probably similar to the Chamotte mentioned by Mr. Makemson in his Report on his visit to the International Foundrymen's Conference. Chamotte contains about 37 per cent.

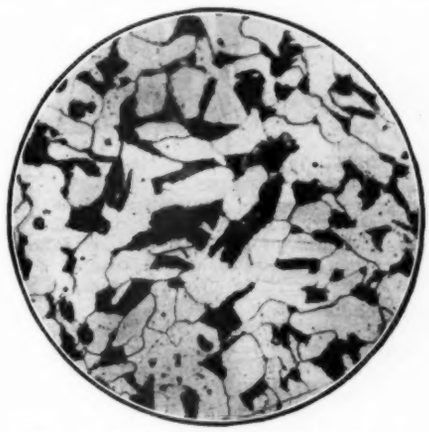


Fig. 8.—0.15 Carbon Steel, Annealed. ×100.

alumina and 58 per cent. silica, and is an excellent bonding material. This mixture was milled with added moisture until it attained the consistency of builders' mortar. The wet compo was then placed on the tops of the mould-drying stoves. These stoves were built with flat roofs and of sufficient stability to withstand a load of several tons of compo. The compo thus stacked was left to dry until it contained about 3 per cent. of moisture, and, after riddling, was ready for use. Dried and matured for several weeks as above, the compo was certainly much better than that marketed to-day.

The same procedure and mixings were used in making the black variety with the exception that old clay crucible pots were used instead of fire-

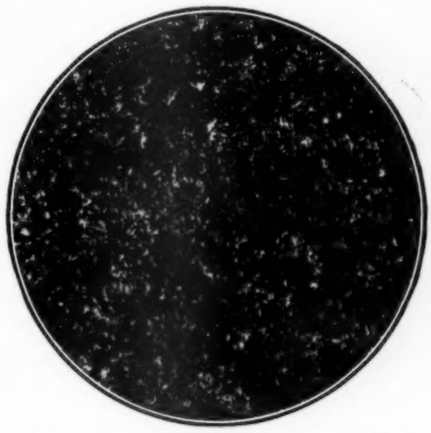


Fig. 9.—0.40 Carbon Steel, Oil Quenched at 880 deg. C. and Tempered at 550 deg. C. ×100.

bricks. This was used for medium and light castings, and with the addition of Calais silver sand, the lightest castings could be made with safety. For cores that were surrounded by heavy sections of steel, black lead was added to the moisture. The addition of black lead prevented the compo becoming fritted together, which caused trouble and expense in the dressing shop.

Facing Paints

The paint used for the faces of the moulds and cores was a mixture of black lead, china clay,

core gum and old clay crucible pots. When the pattern was withdrawn from the mould, as little water as possible was put on the face in finishing, the idea being that the surface should be left dry so that the steel paint afterwards applied to the mould face might be absorbed. After painting, the moulds were sleeked with tools, care being taken to sleek only one way so that the surface should not be disturbed Thoroughly dried, the moulds were then withdrawn from the stove and, whilst hot, a coating of tar, from which the water had previously been driven was applied to the surface.

Notwithstanding the scarcity of old crucible pots, it is still possible to make a very good refractory composition from the following materials:—Black lead, china clay (a high-alumina clay), good-class old bricks, clean coke or, better still, old graphite electrodes, or old graphite crucible pots, and silica sand. With regard to the cost of composition, it is much more expensive to use than natural moulding sands, and will probably be in the region of 40s. per ton. Whilst composition cannot be excelled from a refractory point of view, it takes longer to finish a mould and drying costs are heavier. The best results are only obtainable with moulds which have been thoroughly dried. Hence, apart from the production of special steels and heavy section castings, composition is not in general use.

Most foundries use the natural sands found in this country and on the Continent. The mixings and analysis of the various sands were given by Mr. Barclay in his Paper which is recorded in the I.B.F. Proceedings for 1929-30, and need no repetition in this Paper. The necessity of obtaining a good mixing of the sand with a minimum of moisture, for facing the mould, should be stressed. The same care should be taken with the backing sand.

Equally important is the permeability of the mould. Free passage must be provided for gases evolved during pouring. The use of the water brush on the surface of the mould should be limited absolutely to a minimum, otherwise scabby and porous castings will result. If the steel moulder would realise that as much care is required in the venting of a steel mould as is necessary in the making of a green-sand cast-iron mould, the management would be well on the way to reduce the number of wasters and obviate some for steel-foundry troubles.

Core Sands

The composition of core sands is, of course, varied to suit the type of casting for which they are required. With the present supplies of sands and the wide variety of oil and other binders, it is comparatively easy to produce satisfactory cores for the most intricate castings. In very light castings, cores made from white silica sand with an oil binder is all that is required. In heavier work, it is advisable to use a sand with a certain amount of natural bond (hydrated silicate of alumina), otherwise sagging may take place. Quite heavy castings may be cored successfully with oil sand provided that the sand base will stand up after the oil has been burnt out, and that the face of the core does not scab or flake off. The great advantage of using oil sand is that cores can be made without the use of cast-iron grids usually required in making cores of ordinary sand. Loose irons and lifting staples laid in during ramming will be found of sufficient strength to lift the oil-sand core. The elimination of cast-iron grids in core-making minimises the risk of hot pulls and tears during the contraction of the casting, the core collapsing under contraction pressure. In very heavy section castings the use of compo, with the addition of black lead and graphite, painting and tarring the face of the core make a good refractory facing. The material adjoining the facing compo should be a mixture of sawdust and old sand, with small dry ashes filling in the centre. These small ashes are necessary to avoid any pockets of gases forming which may ignite and cause an explosion. The essentials of a good core sand are high-silica content, fairly large grain and the limitation of moisture to approximately 3 per cent. It only remains to say that the knowledge gained in daily practice, combined with scientific control, will assist in obtaining the desired results as far as the skin of the casting is concerned.

Heat Treatment

Converter steel responds to treatment quite as readily as steel made by other processes. There appears to be little justification for the assertion that oxide inclusions retard refinement. Present requirements may demand any of the following treatments:—Annealing, normalising and water or oil quenching with subsequent tempering. The usual low and medium carbon cast steel in the "as-cast" condition is a coarse crystallisation of pearlite and ferrite which may be refined by heating through the upper critical range. The range temperatures are governed by analysis, carbon having major significance. Briefly, the structural changes are as follow:—At Ac_1 a change in the pearlite takes place—it reverts to the solid solution austenite. As the temperature advances, austenite dissolves the ferrite until at Ac_3 there is the solid solution austenite. In a mild-steel casting, a near approximation of the critical temperatures will be: Ac_1, 730 deg. C.; Ac_2, 760 deg. C.; and Ac_3, or the upper critical range, 830 deg. C. In cooling, the thermal effects are at Ar_3, 800 deg. C., re-precipitation of ferrite from the solid solution austenite commences and continues through Ar_2, 760 deg. C., until at Ar_1, 60 deg. C., austenite reverts to pearlite. In treating castings, consideration must be given to the rate of heating, soaking time at temperature, and rate of cooling. An ordinary anneal consists of heating through the upper critical range and giving sufficient time at the annealing temperature to ensure complete diffusion, followed by furnace cooling. Temperatures much in excess of Ac_3 are not recommended and are definitely harmful in that they encourage re-coarsening—a defective structure which can only be remedied by a double treatment of normalising and reheating, with furnace cooling. Heavy castings on occasion show this defect even with every care in annealing. The very slow cooling through heavy sections seems to encourage reversion to the original structure. Prolonged soaking frequently proves effective in obtaining the desired refinement.

Re-coarsening by overheating may be explained by the fact of the ferrite being already in solution; the increase in temperature over Ac_3 is unaccompanied by diffusion. Consequently, the crystals are enabled to arrange themselves with greater regularity, and the planes of easy cleavage are reintroduced along which the ferrite precipitates on cooling down. A well-annealed steel should show the original coarse crystallisation to have been replaced by a uniformly fine crystallisation, with strong interbonding and the abolition of the straight lines of ferrite. Annealing leaves the casting free from strains, gives high ductility and good machinability. Some further refinement of structure with increased yield and ultimate strength may be obtained by normalising. This process is similar to annealing with the exception that a slightly higher temperature is used and cooling takes place in air. The higher mechanical tests obtained are offset by the reintroduction of strain and embrittlement, remedied only by a reheating or tempering treatment followed by cooling in the furnace. Castings normalised and tempered show higher fatigue and impact values than castings which have been annealed. To develop mechanical properties to the fullest degree, castings should be heat-treated by liquid quenching followed by tempering. This treatment, of course, is rarely demanded on castings with a lower carbon content than 0.25 per cent. It is a frequent requirement in alloy-steel castings specifications. The quenching media may be oil or water—preferably oil. Water possibly gives a greater degree of refinement and higher tensile strength, but for castings of uneven section it is too drastic. In a general sense, it is not essential to give castings for this treatment a preliminary anneal or normalise, but when high impact value is desired it is advisable. Castings should be heated just above the critical range and given the requisite soaking period before immersion. They are removed from the quenching bath before becoming quite cold and returned to the furnace for tempering. Each steel has definite limits within which the physical properties may be varied. At one end of the tempering scale there is a maximum tensile strength with minimum ductility. At the other end, there is a maximum ductility with a minimum tensile strength. Each increase in the tempering temperature lowers the tensile and increases the ductility. It is usual to cool the castings in air from the tempering temperature, but the authors are of the opinion that furnace cooling is to be preferred, or, at least, the castings should be piled to retard cooling. Cooling in air from tempering temperatures may set up a new series of strains and many of the real advantages of this treatment may be nullified. In the case of some alloy steels, such as nickel-chrome, furnace cooling is not of advantage. Air-cooling and even quenching are recommended as a means of avoiding temper brittleness (Figs. 7, 8 and 9).

Before concluding this Paper, it seems germane to mention that the Iron and Steel Institute some years ago formed a Steel Castings Research Committee to investigate and report on steel castings. In their first report they say it is often impossible entirely to avoid defects, such as cavities and shrinkage holes. A sufficient freedom, and not absolute immunity from defects, is all that is required. This, it may be taken, is their considered opinion after visiting various foundries and having had the opportunity of thoroughly examining castings which may be termed difficult. It is also interesting to note that the American naval authorities have considered it worth while to send Lieut. Shane to Europe to get first-hand information of the procedure adopted in the production of steel castings. The Admiralty has also been very active in this respect, and it can be stated that the very helpful advice and its suggestions, as well as those of other surveyors, have assisted considerably towards an improvement in the quality of British steel castings.

Annual Congress of the Association Technique de Fonderie

The thirteenth Annual Congress of the Association Technique de Fonderie will be held at Nancy (Meurthe-et-Moselle), France, on Friday and Saturday, July 20 and 21.

Visitors will thus have the opportunity of visiting the interesting Fair-Exposition, where they will be cordially received by the Administration. The University of Nancy will open its doors to them, and visits to various Technical Institutes and laboratories devoted to the study of metals, refractories, etc., will be organised, as well as visits to plants and tours in the surrounding country.

A detailed programme will shortly be published. The French Association extends a cordial invitation to all persons interested in foundry questions to participate in the Congress. Those desiring to present a Paper on any technical or scientific subject relating to the foundry are requested to communicate as soon as possible with the Secretariat of the Association Technique de Fonderie, 44 rue de Rennes, Paris (6e).

Messrs. Bessler, Waechter & Company, Argentine Agency, Limited, is being wound up voluntarily. Mr. H. C. Ogilvy, Salisbury House, Finsbury Circus, E.C.2, is the liquidator.

XUM

Plastic Moulding*

By J. L. Daniels

This Paper is to be a brief survey of modern moulding practice with synthetic resin moulding powders. It is not intended to deal with the historical side of the industry, nor the bitumens, rubber, ebonite, or the large casein industry.

The Materials

The range of materials available for the synthetic resin moulder can be divided into two heads—thermo-setting and thermo-plastic—the latter requiring cooling before they can be removed from the mould. Of thermo-setting materials the best known are:—

Phenol formaldehyde, Cresol formaldehyde } Bakelite.
Urea formaldehyde — Beetle.

There are several types of thermo-plastic resins, but only the more recently developed forms, cellulose acetate and benzyl cellulose, will be dealt with.

The phenol formaldehyde resins are produced as a condensation product after phenol (which is a coal tar derivative) is distilled with formaldehyde. The resulting synthetic resin is a clear brittle amber coloured material, in appearance not unlike its natural counterpart. This resin is then finely ground and mixed with a filler to give cheapness, lightness and strength. The common fillers are wood flour, fine paper pulp, while asbestos is used to make a heat resisting mixture, and torn linen or rag for special shock resistance. Cresol or mixtures of cresol and phenol are often used in place of pure phenol for certain specific purposes.

The urea resin is a similar product produced from urea or thiourea and formaldehyde. Fillers and pigments are added and the material is mixed, dried and ground. The urea resins have valuable properties, inasmuch as they are clear and colourless, and therefore a very wide range of colours are obtainable, from the purest white down to black.

Pigments are added to give finished materials of pleasing colours. The urea materials are translucent and very beautiful in colour.

The raw materials are loose powders, which have to be stored in air-tight containers or bags, in case they should absorb moisture and spoil.

These powders have one very interesting property, and that is that under the influence of pressure and heat they become plastic, and take up the shape of the mould into which they are pressed. This plasticisation continues for a period and then a further chemical change takes place, called polymarisation, and when this is complete the resinous material becomes a solid mass, and for all practical purposes inert, and may be removed from the mould as a solid moulding, without waiting for cooling. This property defines the main physical difference between thermo-setting resins and thermo-plastic materials, as the latter remain in a soft condition until they are cold, and will become plastic again on further application of heat.

The thermo-setting resins are not softened by heat again after complete polymarisation occurs, and this forms a very definite dividing line between the foundry practice and moulding practice. The resin is brought out through the filler against the surface of the mould, which is hard and highly polished, and the resulting surface of the moulding is also highly polished.

Relative

Let us now compare the physical properties of the synthetic resin materials with those metals so familiar to foundrymen. As to density, the relative weights per sq. in. are: brass, 0.30; cast iron, 0.26; aluminium, 0.10; and synthetic resin, 0.05 lbs. It will thus be seen how much lighter it is than the metals.

Price.—To-day price is an all important factor, sometimes too important. An average powder in plain colour can be bought for about 84s. per cwt., and when one considers the difference in density this compares favourably with brass, especially when one remembers that the moulding leaves the mould highly polished, and it does not tarnish or need fettling or machining.

Tensile Strength.—The relative tensile strengths are set out in Table I.

Incidentally the bakelite materials possess a high electrical resistance.

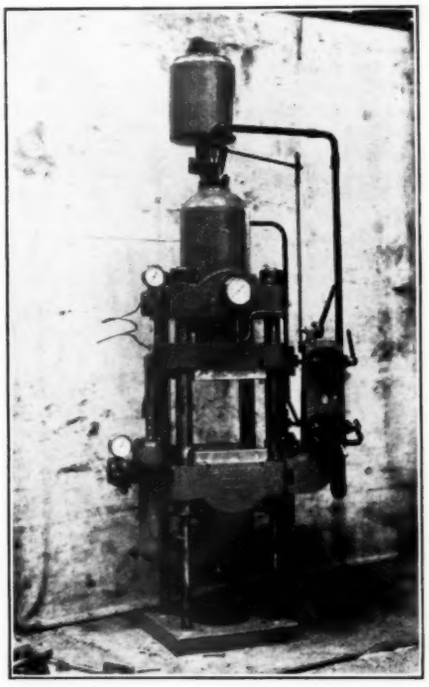


Fig. 1.—50-ton Downstroke Double-Acting Press, with Electric Platens and Prefiller Valve and Tank.

Table I.—*Tensile Strength of Bakelite in Comparison with Foundry Alloys.*

Material.	Ultimate tensile strength.	Young's modulus of elasticity.
	Tons per sq. in.	
Cast aluminium ..	6–20	11×10^6
Cast brass	10–20	9×10^6
Grey cast iron.. ..	9–18	12×10^6
Bakelite X 20.. ..	2.9 — 3.35	$7–8 \times 10^5$
Bakelite X MB 199 ..	2.5 — 2.9	$6.5–7 \times 10^5$

Mechanical Details

Under the influence of pressure and heat the resin becomes plastic, and this raises such questions as pressure, temperature, and how this is accomplished.

The pressure is usually exerted by means of a hydraulic press, although mechanical and hand-screw presses are also used for the purpose. Fig. 1 shows a typical downstroke hydraulic press, together with motor-driven pressure pump. The mould is fastened to the platens, which in the case of this press are heated electrically. Next the necessary amount of powder, plus a little surplus to ensure that the moulding will be a complete one, is placed into the mould. For phenol powders the moulding temperature should be about 170 deg. C. and 149 deg. C. for urea powders, and this temperature is maintained by means of an electrical thermostat which switches on and off the current. In the case of large installations the platens are usually steam-heated at 180 lbs. per sq. in. from one central boiler supplying all the presses, and the temperature is regulated by reducing valves.

An alternative to this is heating by water under pressure, and this has the advantage that steam traps are eliminated, although a circulating pump is necessary. On some small installations gas-heated platens are employed, but temperature control is not so fine, and there is the liability of fumes in the shop.

Having loaded the mould the press is closed and kept closed for some time, say 2 or 3 minutes, depending on the size of the moulding and the necessary curing time; this is usually ascertained by trial and error, but there is a rough and ready rule of 20 to 30 seconds for each m/m in thickness.

Next the press is opened either by gravity, springs, or hydraulic push back cylinders. The moulding is extracted by hand after removing the mould and opening it with levers in a hand-screw press, or if the mould is fixed in the press the two halves of the mould are parted by means of the hydraulic cylinders, the moulding removed by an ejecting pin rising up in the centre of the mould, or it is blown out by compressed air.

The moulding will have its surface polished like the mould surface, but the thin flash or fin will still remain at the joint of the mould, and can be removed with a file, in a flash grinder, or in the case of some small articles by barrelling. Unlike the surplus material of the foundry this cannot be utilised again, and the flash is waste. In the interests of economy and efficiency it is therefore necessary to reduce this to a minimum, and some shops operate at 5 to 12 per cent. If this proportion is cut too fine it may sometimes result in too little material, and a waste due to a short moulding.

Moulds

The mould is the essence of the whole job. In the foundry the moulder is the man who makes the mould, whilst in the plastic moulding trade the moulds are made by toolmakers, who are more important even than the pattern-makers in the foundry industry.

When it is decided to mould an article, the tool designer examines the job, and suggests to the customer modifications that can be made to the article, making it more easily moulded, improving its line, and thinning it here and there. Then if the customer approves the mould is begun. Moulds are made of steel, carefully heat-treated. They may be made of mild steel and case-hardened, but if this is done then care must be taken not to over-stress the mould, in which case the structure of the steel may collapse beneath the hardening. Special alloy steels are now in general use, containing nickel and chromium, and these moulds require special heat-treatment. All moulds require very careful grinding and polishing after heat-treatment, as on this polish depends the finish of the article, and the satisfaction or otherwise of the customer.

A simple mould will require top force, bottom force, landing, and dowel pins. The dowel pins serve the same purpose as the dowels on moulding boxes, as they bring the corresponding portions of the mould together. They need to be accurate and of heavy construction, because it must be understood that the moulding is subjected to pressures reaching 2 tons per sq. in.

Slight tapers are a great help towards easy extraction of the finished moulding, because

*Paper read before the Birmingham Branch of the I.B.F.

the mould is a permanency and cannot be scrapped to remove the moulding. Bored holes are only possible if they are straight; it is, for instance, impossible to produce a synthetic resin moulding in one piece as complicated as a jacketted gas engine cylinder, or breach end. The moulder always tries to avoid the use of loose pieces, although at times they are unavoidable. In moulding a vacuum-cleaner cup, for instance, a loose piece is employed for forming the handle; this is ejected with the cup, tapped out, and then replaced in the mould.

Moulding Plant

In this industry the hydraulic press is the important machine. It consists essentially of a cylinder, a ram moving a table guided on columns, and a press head. To-day, however, presses are invariably fitted with an additional cylinder or cylinders for separating the two

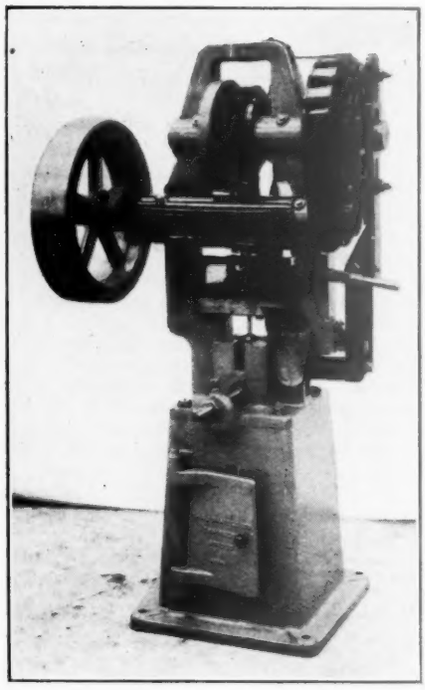


FIG. 2.—TABLETTING MACHINE.

parts of the mould (which are fixed to the platens) and extracting the moulding.

To prevent the hydraulic fluid from escaping a packing and gland are fixed to the cylinder, and these, as all moulders and plant manufacturers realise, are one of the bugbears of the industry.

The pressure fluid, which is controlled to the press cylinders by valves, is supplied by means of a pump, which may be a self-contained unit, as shown in one of the earlier slides.

Tabletting

In order to reduce the time required for weighing, to minimise flash, and reduce the possibility of light moulding, it is usual to measure out the powder and compress into tablets in machines such as is shown in Fig. 2. Other advantages of this are that owing to the compression of the powder the cavity of the mould need not be so deep. The tablet is less liable to absorb moisture and a better electrical moulding is the result. Much of the air is driven off, and therefore it cannot be trapped in the moulding.

Preheating

When the powder is introduced into the mould it takes heat from the mould until it reaches, or nearly reaches, the mould temperature. If the powder in tablets is heated prior to being placed in the mould the immediate advantages are twofold; the heat of the platens is saved, and the curing time is reduced. Other advantages are found to be:—(*a*) Better electrical moulding due to the moisture being driven off; (*b*) less breakage of fine inserted pins; (*c*) elimination of a wavy ripple marking so prevalent in the flat moulding, and (*d*) more even flow.

Thermo-Plastics

Although of much less general importance, thermo-plastics will be of interest to the foundrymen, because they are more allied to the die-casting foundry. Cellulose acetate is probably the most common thermo-plastic synthetic resin in general use. This material is prepared from cotton linters and acetic acid in the presence of a suitable catalyst (the most usual of which is sulphuric acid). Cotton linters are the short fibres left after the cotton for textile use has been removed from the seed. The linters are first boiled with caustic soda solution under pressure to remove the oil and impurities, and are then bleached. The resulting cellulose acetate is then mixed with suitable pigments on rolls, and ground up into moulding powder.

These are two methods commonly used in moulding it.

(*a*) *Compression Moulding and Injection Moulding.*—The process of compression moulding is generally similar to the methods given for thermo-setting materials, except that the moulding temperature is much lower, being in the region of 125 deg. C., and the moulding must be cooled to set it before it can be removed from the die. For this reason it is necessary to use steam as the heating medium, and to have cooling water to circulate in the steam passage for cooling. The process is slower than ordinary moulding, but it is surprising how quickly steam heats the moulds.

Injection moulding is usually carried out with quick operation and a relatively small number of impressions in the mould, and up to the present time is only applied to small mouldings up to, say ½ oz. The essential features of all the machines are, first, a cylinder in which the material is heated, and the mould into which it is to be injected. When the material has reached a suitable temperature a piston is pushed into the cylinder, and the plastic material forced out the nozzle at the end of the cylinder into the mould, which is held mechanically against the nozzle. After an injection stroke the mould is removed from the nozzle and taken apart, and the moulding ejected or lifted out by hand. A typical press is shown in Fig. 3. This process is particularly suitable for small, thin mouldings of intricate shape. Generally speaking, the moulds are not water cooled, but they rely on the mass of cold metal in the die or mould for cooling.

Shrinkage

Allowances have to be made for shrinkage on all moulds, when the finished dimensions are important. It is usual to allow from $\frac{1}{16}$ in. per foot for phenol powders, which is very little compared with $\frac{1}{8}$ in. per foot for cast iron, $\frac{1}{6}$ in. per foot for brass, and $\frac{3}{16}$ in. per foot for aluminium.

Inserts

It is possible to mould in metal inserts if they are not too large. These are first placed into the mould and the powder or tablets placed round them.

Laminated Materials

It is said that some years ago one of the large railway companies made and used a number of wagon wheels whose centres were composed of paper sheets tightly pressed together banded with welded steel tyre. One of the very important developments of this industry has followed on these lines. Laminated sheets are made from either paper or linen impregnated with synthetic resin. These sheets are pressed out between polished steam heated plates on powerful hydraulic presses. These presses need to be powerful, and it must be realised that approximately ½ ton per sq. in. pressure is needed over all the area of the sheet. Quite a useful size of sheet is 48 in. × 30 in., which needs a press of 1,500 to 2,000 tons. This branch of the industry calls for heavy and expensive plant and accurate workmanship to ensure sheets of uniform thickness.

The common uses of laminated sheet in phenol resins are for switchboards, and other similar electrical work. The use of laminated sheets in the furniture industry is developing, and also the practice of synthetic resin veneers with table tops, etc.

A growing use of the laminated sheet which is always of the linen-impregnated type is for gear

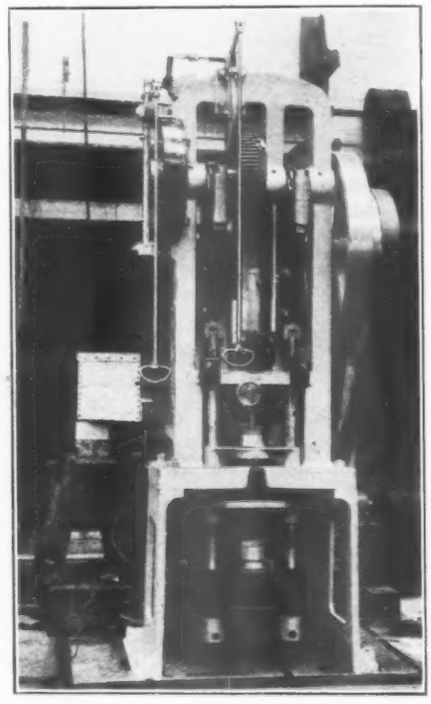


FIG. 3.—INJECTION MOULDING MACHINE.

wheels. The sheet is as thick as the face of the required gear, and consists of a multitude of sheets closely bonded together. The laminated sheet is turned up on a lathe and the teeth cut in the usual way, as they would be from a cast iron or steel blank. It is worth noting that the teeth are cut and not moulded, if they were moulded it would be necessary to cut each sheet of linen to the approximate shape of the finished gear. Such gears are light, possess a long life, are durable, and, above all, are silent, or nearly so. One case is on record where a pinion of this type driving from an electric motor on to a hydraulic pump outlasted the gear wheel.

Laminated sheets are also made from urea materials, and are used extensively for decorative purposes, for the walls of rooms, etc., where the choice range of colours is very attractive.

Uses

It is sometimes suggested that synthetic resins are driving out brass stampings on cast iron for switchboxes, etc., it is also held that it is a synthetic material, and that to-day is an age of synthetic substitutes. In a sense it is, and perhaps these accusations are true, but it seems desirable to indicate a few of the suitable uses of the various materials. It is not put forward

as a complete list, or the remainder of this Paper would be nothing but a catalogue.

The synthetic resins are excellent non-conductors of electricity, so it is no wonder that so many moulders have specialised in electrical fittings, especially when it is recollected that the moulding industry, and the wireless or radio industry began almost at the same time, and have risen together.

The old pressed brass lampholder was dangerous, as is well known. It corroded in fumes of the shop and even in the home; what more suitable material could be found for the job? With the growth of the grid scheme, and the electrification of the rural areas, there has been a tremendous field for this class of goods. Then there is the case of switchboxes replacing cast iron, which certainly gave a clean line produced direct from the mould, with no fettling, no stopping and no painting; bakelite is a non-conductor and cannot rust. Some of these mouldings are thinner than the cast iron; there is no machining to do, and the lettering appears clean and plain.

In these two instances given above nobody could call the moulding a substitute; it is a simple case of a material having come into its own.

Door furniture and finger plates are produced in considerable quantities, and the fact that there is no cleaning to do has found them a warm place in the heart of many a hard-worked housewife.

A large moulding is exemplified by an adjustable fender complete, moulded in 3 pieces from phenol resin. The line is clean and pleasing, and it can be obtained in any colour to match the colour scheme of the room. Again there is no cleaning or polishing.

In urea materials there is a very large range of table ware and picnic sets. The reason for the choice of material is the beautiful range of colours and the translucent effects. Again, switch covers and domestic electric light fittings come to the front.

Cellulose acetate is used chiefly for small mouldings up to ½ oz., and bobbins for telephones, wireless, golf tees, fountain pens and propelling pencils are typical of the range. Several attempts have been made to popularise the cellulose acetate gramophone record, as it is light, cheap and flexible.

It is only commercial to make bakelite moulding when very large quantities are called for, as the cost of manufacture is regulated very largely by the cost of the dies, and the whole process can only be carried out on definite production lines. It is not feasible to make a mould when just a few dozen mouldings are required, unless the customer is prepared to stand the cost of the mould.

What of the Future?

In general the author is confident that where, by reason of its physical properties, artistic merit, adaptability, or cheapness, synthetic resin mouldings are the most suitable material for their job, they have come to stay. There may be cases where by reason of their very newness and popularity, rather clumsy and inartistic mouldings may be used at present, but these will not survive.

The size of mouldings will get larger, and probably furniture will be made from synthetic resin materials, and there are already firms producing domestic refrigerators complete from these materials. It may be thought that from this Paper the author has suggested that synthetic resin mouldings are replacing cast iron, brass, etc., but he does not think this is true. Where synthetic resin is the obvious material to use, it will be used, but it will never replace cast iron for such heavy duties as lathe beds, engine frames, etc., because it is really unsuitable for the job, and the material called for is one which can give rigidity and weight.

DISCUSSION

In proposing a vote of thanks to the lecturer, Mr. G. W. Brown referred to the very fine display of exhibits which the lecturer had brought, and remarked that he had been surprised by the progress made in this new medium, the range of articles shown was proof that this new industry was very much alive. Was the temperature at which the actual pressing took place of great importance, and, if so, how was it possible to be sure that the whole of the powder was at the correct temperature? Was trouble experienced in obtaining a perfect flow of the materials into intricate shapes, and was it found that air-vents were necessary, as none was apparent on the dies shown on the slides? With reference to the comparison of the production of mouldings with the production of castings, Mr. Brown said that it was obvious that the tackle required for the production of mouldings on a large scale was very expensive. The dies shown by the lecturer were for the production of single articles, and the fact that one could use twenty or more patterns on one plate in producing small articles in grey iron, seemed to be in favour of the latter. Was he to understand that the mixtures used for "mouldings" were standard, as if so this was an advantage over the foundry where there were no standard mixtures. In conclusion, it would appear that there were plenty of technical problems to be solved by the manufacturers of this new product, some of which would perhaps help them to appreciate the skill of the ironfounder in solving similar problems.

Physical Properties

Mr. A. Tipper, in seconding the vote of thanks, said with regard to the comparison of the physical properties of mouldings with those of grey cast iron, the maximum tensile strength of 18 tons given for grey iron could easily be exceeded to-day by the modern engineering cast irons. He thought that each material had its own field of usefulness, and that where strength or weight were required, cast iron would hold its own. He had rather expected to hear more details of the mixtures used and data on the behaviour of these materials under rapid changes of temperature, under shock, and the effect of ageing, etc. There was a big field for investigation into the properties of these raw materials.

Heat Resistance

In opening the discussion, Mr. E. J. Lewis (Branch-President) asked if the wear on the dies was severe and if any idea could be given of the average life of a die. Referring to a large moulding in the form of a curb which had been exhibited, he asked would the material stand up successfully to such service or would the curb tend to buckle and char when subjected to the heat from the fire?

Wear Resistance

Mr. W. J. Molineux said it appeared that competition from mouldings was to be feared by other industries and very little by the foundry. He would like to ask the lecturer if mouldings would ever be used in the place of castings where wear resistance was required, for example, in motor-car cylinders. Was the material resistant to weak acids, and under what conditions would it disintegrate?

Mr. H. G. Hall asked if the scrap could be used again, as if the material were useless this appeared to be a serious snag.

As a Core Binder

Mr. J. J. Sheehan asked if liquid bakelite had ever been tried as a core binder? It appeared likely that this material might produce very little gas when burned, and therefore might have possibilities in this field if the price were not prohibitive. Could this liquid bakelite be cast, because if so it would put production on a more competitive basis with cast iron?

Mr. Tipper said that with reference to Mr. Sheehan's remarks, a liquid bakelite had been put on the market as a core compound, but the cores obtained with it had not such a high strength as those obtained by the use of a good ordinary core-compound. The price of the material was also against its adoption in this field. He would like to ask the lecturer if the structure of plastics had been examined and whether the material was permeable to gases, or liable to absorb moisture? Was a yield point obtained in the tensile test and, if so, what relation did this bear to the breaking strength?

As Pattern Plates

Mr. J. B. Johnson said that it was a pity that a material which took such a beautiful finish could not be used for pattern plates, but apparently this was not possible. He thought that there was a very great future for this new industry, and in a way the foundrymen would share in this as the presses used in the manufacture of mouldings were largely the product of the ironfoundry.

Mr. Grainger asked if the lecturer could give the pressure used in the production of a plate 17 in. square, which was exhibited? He would also like to assure the foundrymen that the scrap produced was not a big snag. He had heard of firms re-using the whole of the scrap. If the scrap had been poliminarised it could be powdered and used as a filler, and when used in this way it was sometimes found to increase slightly the strength of the moulding.

Life of Dies

Mr. Goode (The Institute of the Plastics Industry) stated that he knew of a die producing lampholders at an average rate of 25,000 per week for twelve months, there being twenty-five impressions in the die. Other dies containing fifty impressions had produced 130,000 to 140,000 mouldings per week for considerable periods without showing serious wear. The tools used in the production of mouldings were expensive, and when they were obtained it was necessary to produce as many articles as possible in order to keep costs down.

Author's Reply

Mr. Daniels, replying to Mr. Brown, said that a surface pyrometer was used for taking the temperature, but the figure obtained was only relative, as this was all that was required to ensure the conditions under which good mouldings were obtained could be produced. There was no difficulty in obtaining a perfect flow of the material into intricate shapes, and it would flow into thinner sections than it was possible to cast. Air-vents were not necessary as these would be immediately closed by the material. With regard to standard mixtures, each firm had its own standards, but a Specification Committee was now meeting to arrange the composition of certain standard mixtures.

With reference to Mr. Tipper's remarks, the speaker said it must be understood that this was an extremely general subject and had to be dealt with in a general way.

Crash Helmets

Referring to the maximum tensile strength of grey iron, he wished that it were possible to produce presses in cast iron of over 20 tons per sq. in. tensile strength, as if so the weights could be cut down considerably. The figures he had given had to be very general and could be taken as a fair average of normal practice. It was possible to obtain plastics with good resistance to shock, and a crash helmet used by miners was exhibited as an example. A linen-filled material was used in this application.

It was difficult to answer Mr. Lewis regarding the question of wear on the dies, as the life of a die depended to a great extent on the treatment or ill-treatment it received. If the die

(*Concluded on page* 351.)

Specially Hard Cast Iron

Several points of vital interest to foundrymen were adduced when Dr. Pfeil presented Mr. W. T. Griffiths' Paper on this subject to the Lancashire Branch. As usual, immediately the Paper was read a vote of thanks was accorded to the author and Dr. Pfeil by Mr. J. S. Glen Primrose, who said it would be quite a revelation to most of the members to think that by annealing, and what they would regard as the softening of cast iron, it could be made to possess, with the additions mentioned, what would be described as exceedingly hard surfaces.

Mr. E. Longden seconded the vote of thanks, stating the crux of the remarks concerning specially hard cast irons and the alloying elements was that the hardness was obtained in conjunction with increased strength and less brittleness. The value and strength of a cast iron depended largely upon the amount of, and condition of, the carbon content; any depth of chill could be obtained by controlling the carbon content by the use of silicon, manganese, sulphur, chromium and total carbon. By means of the special alloys outlined the required depth of chill was maintained, but with greater strength and resistance to the duty or the work that the chilled rolls had to fulfil. He recalled that it was commonly understood in the chilled-roll trade that for hot rolling high-sulphur content was taboo, while for cold rolling it was permissible. It appeared that special alloying elements could be produced with greater benefit to the rolls which were used for hot rolling. With regard to the cracking which occurred in chilled rolls, probably the information contained in the Paper would go a long way to aid chilled-roll manufacturers. Even old-established firms had not at their disposal the information which had been communicated that afternoon. There were various types of cracks in connection with chilled rolls. There was a vertical crack which was attributed to the metal mixture or composition principally, although there were other reasons, and there were also horizontal cracks which were attributed to bad moulding practice, such as resistance to the contracting casting by the mould, etc. He stated that the white chilled area could not be machined. Probably he meant the metal with very high Brinell hardnesses, otherwise it was common to machine chilled rolls. His company manufactured machines which run at much greater speeds than hitherto.

The vote of thanks was carried unanimously by acclamation.

Alloyed Roll Practice

Dr. Pfeil, in responding to the vote of thanks, said that he had not been able to discuss in detail the mechanical properties of alloy chilled irons, and, in view of Mr. Longden's remarks, it might be as well to emphasise that, by means of alloy additions, a substantially increased hardness was obtained over that of plain chilled iron of the same carbon content; thus a plain chilled iron having a hardness of 50 Shore could be raised to 70 or 80 Shore by proper alloying, while a higher carbon chilled iron, giving a hardness of perhaps 70 Shore, could by alloying have the hardness raised to 90 or 100 Shore. He was well aware that ordinary chilled rolls could be turned, but these super-hard alloy chilled irons were naturally more difficult to machine, and special tools had to be employed for the hardest varieties. He did not know whether Mr. Longden was referring to the cracking of rolls during manufacture or to fire-cracking in service.

Mr. Longden: In fire.

Dr. Pfeil said that he did not know enough about the roll trade to deal with this point.

Brinell Hardness Machinability

The Chairman (Mr. Phillips) said it had been shown in the Paper how to apportion the elements in order to maintain a certain depth of chill. Those members who were called upon in the future to manufacture chilled castings would no doubt use the excellent Tables which had been placed before them. Referring to hardness and machinability, sometimes castings showed a Brinell number of about 250 hardness. These were machined quite readily. Again, there might be a casting showing a Brinell hardness of, say, 230 and which was very difficult to machine. He would like to have an explanation of why a casting which had a higher Brinell number, which was an indication of its hardness, was more readily machined than another casting which had a lower Brinell number.

Mr. A. Sutcliffe (Bolton) asked whether chilled bowls could be made from cupola metal, and whether the white or grey portion liquefied first on remelting such scrap. He had brought four samples for the members to examine. One was a portion of a high-speed cylinder which had been in use a considerable number of years. A second, a pulley, was made by T. Jacksons, of Bolton, a firm which was now out of existence. He smashed the pulley and found that it had an exceedingly close grain.

Mr. Glen Primrose said it was cold-blast iron.

Effect of Elements on Crucible Life

Mr. Reynolds inquired whether the lecturer would give him the benefit of his experience with high-alloy irons, and principally of the austenitic form, as to their effect on crucibles. He had had a few years' experience of the high-manganese, nickel and copper type, which seemed to rot the crucible. After less than a dozen heats it seemed to eat away the clay, and the graphite seemed to coat the molten iron, so that when the castings were poured they were simply covered by flakes of graphite and the metal was sluggish and porous.

Was there any remedy for that state of things? He would like to add that chilled rolls could be turned. They were turned in his own works, in common with other rolling mills, but were not turned like ordinary cast iron with a big speed and feed. The turning was done with a fairly wide tool, and the cut made at a low speed; the roll barely turning round. The rolls were ground to the finished dimensions. He had had a fair amount of experience of alloy irons. He was rather surprised that the lecturer should have used (even for experimental purposes) several alloy elements which seemed to balance or fight one another. The majority of irons he had used with success had been of the low-silicon type with nickel alone. His experience was that using higher-silicon irons required chromium adding, which increased the cost, and added another complication. Chromium was difficult to control, being more easily oxidised, and it resulted in hard spots in the metal. It was more difficult to obtain consistent results with chromium alloyed with nickel and high silicon than was possible with low silicon and nickel alone.

Effect of Molybdenum

He had tried molybdenum, but it was the most expensive constituent he had used. Could the lecturer state what was the effect of molybdenum with, say, 1 per cent. silicon, 3 per cent. carbon and 0.5 per cent. manganese; because if it presented any points of interest or advantage over the elements he had used already he would certainly make some more experiments. He found, upon reading all the authorities available, that the results obtained were rather confusing; some stating that it was a hardener, while, in some instances, others stated it was a softener.

Replacing Nickel by Copper

Mr. H. E. Beardshaw (Worsley) asked whether Dr. Pfeil had any views to communicate respecting the substitution of copper for nickel. He would like to range himself on the side of the lecturer and point out that founding practice had now reached a state of extremely high development. It was the type of information contained in the Paper which was going to lead up to the only avenue in which the ironfounding industry could exist. He felt rather sorry for the lecturer when he commenced to read the Paper, because, knowing the Lancashire Branch as he did, he knew the lecturer was going to be immediately in conflict with the moulders and the patternmakers. It should be pointed out that their branches of the trade were intensely developed and did not leave much room for improvement, which was all to their credit. The only avenue for further development was the one outlined in the Paper, and it was worthy of careful consideration.

The Chairman wished to support the statement of Mr. Beardshaw about the use of alloy irons in the near future. When a lecturer came among them and spoke of martensitic, austenitic, pearlite and cementite structures they need not be alarmed and think the Paper did not apply to them. It was merely phraseology, meaning that martensitic structures were hard and austenitic structures soft, and so on; in fact, they came into contact with them everyday in different terms.

AUTHOR'S REPLY

Dr. Pfeil said that the hardness of cast iron was an average value of at least two constituents, and generally more than two constituents. One of these constituents might be very hard, but small in quantity, with the bulk of the metal soft, as a result of which a low average hardness would result. In another case there might be a complete absence of very hard constituents, and yet the bulk of the metal consisted of fairly hard material. The iron containing the hard particles might give the lower hardness value of the two, and yet prove the more difficult to machine, owing to the tool edge being damaged by the hard particles. Machinability could not be judged entirely on the basis of hardness, and he had experience of irons softer than 230 Brinell which were extremely difficult to machine. He referred particularly to improperly-alloyed austenitic cast irons containing nickel, copper and chromium. Machining difficulties in irons of this type could, however, readily be overcome by adjusting the composition so that the iron was in the stable austenitic condition.

Influence of Manganese on Crucible Life

In reply to Mr. Reynolds, Dr. Pfeil said that manganese was a readily oxidisable element, and in non-ferrous alloys, as in iron, manganese in quantity was liable to cause trouble, owing to the formation of manganese-oxide and the high affinity of this oxide for the siliceous material from which crucibles and furnace linings were commonly made. Where high-manganese mixtures were melted in clay graphite crucibles, the manganese would be liable to oxidise, combine with the clay, and form slag, and thereby free the graphite. He did not think it was possible to overcome the difficulty except by preventing oxidation, a somewhat difficult proposition.

Mr. Reynolds, like Mr. Longden, raised the question of machining chilled iron. With the tools ordinarily used for chilled iron it was a commercial proposition to machine the less hard varieties of chilled alloy iron, but where the maximum hardness was developed in the iron, turning in the lathe was not the best proposition for the barrels of rolls, although satisfactory for the necks.

Balancing the Elements

With regard to the adding of alloy elements in balanced proportions, he thought Mr. Reynolds was referring to grey iron and not to chilled iron. In the case of grey iron the addition of

nickel was best accompanied by a lowering of the silicon content. Although iron caused difficulties in machining, due to the presence of hard spots, nickel additions might be made without other changes in composition. In grey iron, although a nickel addition improved machinability, it also strengthened the iron, due to its grain-refining influence. Chilled iron was a different proposition, for all alloying elements affected the depth of chill, some increasing it and others decreasing it, and, therefore, one alloy element alone was not usually satisfactory. The control of chromium additions to iron was more difficult than that of nickel or molybdenum, owing to the ease with which chromium was oxidised. Furthermore, high-chromium levels in chilled iron cause a spreading of the mottle zone. Chromium has a somewhat similar effect in grey irons, where its presence is liable to introduce mottle, with accompanying machining difficulties.

Rôle of Molybdenum

He thought it was correct to describe molybdenum as a hardener of iron, as it had a tendency to increase the chill, but he did not know on what grounds molybdenum could be described as a softener for iron. From the experiments which have been carried out in the Laboratory of the Research and Development Department of the Mond Nickel Company on chilled alloy iron, he would be inclined to describe the action of molybdenum as intermediate between that of chromium and that of nickel. He thought that molybdenum made iron easier to harden by quenching, but did not know of any experiments demonstrating that molybdenum was more effective in that direction than other elements.

Mr. Beardshaw raised the question of copper in cast iron. Neither steel nor cast iron would retain a substantial amount of copper, unless some other element were introduced as a carrier. The usual element to employ was nickel, and a good example of this action was given by the austenitic corrosion-resisting and heat-resisting irons, which contained about 7 per cent. copper, together with 14 per cent. nickel. The iron could be made austenitic without the copper, but from the practical point of view it was an advantage to have copper as part of the alloy condition. He agreed with Mr. Beardshaw's remarks concerning alloy irons, and was quite certain that these materials would be used in increasing quantities in the future. By alloying, an iron could be rendered suitable for many applications where plain iron was not good enough, and foundry directorates who turned their attention to these specialised products would reap an advantage.

Engineering as a Career

Mr. John B. Langmuir, welfare supervisor at Messrs. Mavor & Coulson, Limited, Mile End, Glasgow, in the course of an address on engineering as a career at a meeting of the Glasgow Careers Council, said that the use of machines in industry had allowed men to use their brains and to conserve their muscles. Engineering afforded opportunities and scope for the complete range of abilities and educational attainments for all kinds of personal and temperamental qualities and for the full exercise of all the creative instincts. Insecurity of tenure was one of the evils of the engineer, but the insecurity did not affect all people engaged in engineering. It was confined to a fringe of the employees only. The proportion of engineering employees "on the staff" was increasing. If a boy was to derive full enjoyment from his work and to be a success in it he must be interested. The final choice of occupation rested with the boy, but he should receive advice and guidance from his teachers and parents, who knew most about his capabilities. It was desirable that boys who wished to be engineers should receive a practical rather than an academic training at school, but no specific training for engineers was recommended. Training could only be given in the workshops. Among those present at the meeting was Prof. Duron, of the Lycée in Paris.

Iron and Steel Import Duties

ADVISORY COMMITTEE'S STATEMENT

The Import Duties Advisory Committee, in their report on their decision to remove the time-limit on the import duties on iron and steel, recall that on October 13, 1932, they recommended the continuance for a further period of two years of the temporary duties on iron and steel products, "subject to satisfactory progress being made in the preparation of a scheme of reorganisation and in putting the approved scheme into force"; and the period of the duties was extended accordingly by the Additional Import Duties (No. 8) Order, 1932, until October 25, 1934. A report from the National Committee for the Iron and Steel Industry outlining a scheme for a new central organisation for the industry was submitted on March 13, 1933, and in a letter dated April 6, 1933, the Chancellor of the Exchequer stated that he regarded the proposals "as constituting a real step forward in the required direction," but that much remained to be done before the industry could be said to be properly equipped and organised. He went on to make the following declaration of policy:—"While the Government must necessarily reserve complete discretion as to the precise action, legislative and otherwise, they may deem it expedient to take in any circumstances which may arise, I desire to assure you and the industry that, so long as the Government are satisfied of the determination of the industry to set its house in order, they will be ready to give such support to its efforts as from time to time appears necessary to enable this great enterprise to be brought to a successful conclusion."

On receipt of this letter the National Committee entered upon discussions with the various sections of the industry with a view to completing the scheme and adjusting it more fully to opinion in the industry. A completed scheme in legal form came before a special general meeting of the National Federation of Iron and Steel Manufacturers on April 19, 1934, when the new constitution was adopted, and it was resolved to give a special direction to the Council and Executive Committee to be appointed under the revised constitution that, in carrying out their duties thereunder, they should give their earnest attention forthwith to the measures to be taken in collaboration with associations in the industry:—(1) To promote the maximum manufacturing and commercial efficiency throughout the industry; (2) to expand the export trade in iron and steel products; (3) to obtain the affiliation of associations.

Following upon that meeting, representations were made to the Import Duties Advisory Committee by the Federation as to the desirability of an early announcement in regard to the continuance of the duties. Although the Order of October, 1932, was not due to expire for some six months, it was urged that the existing uncertainty was retarding plans for the better organisation of the industry and schemes of capital development of individual plants, and further that it was encouraging foreign producers to continue to export at a loss to this country so as to retain their footing in this market against a possible reduction in the duty after October next.

The present scheme of reorganisation, the Committee state, while of a less compelling character than the outline scheme submitted in March, 1933, is on substantially the same lines, and it has the support of the great bulk of the industry—a fact which should make for rapid progress in its application. The special direction given in the resolution passed by the general meeting of the Federation on April 19 is an assurance that no time will be lost in completing the new central organisation of the industry so that attention can at last be concentrated on the real objects of the scheme as set out in that resolution, namely, to provide the maximum manufacturing and commercial efficiency throughout the industry, and to expand the export trade in iron and steel products.

"It has been our policy throughout the past two years," the Advisory Committee add, "to co-operate with the industry in the pursuit of these objects, and they will govern any recommendations we may submit in future, whether for the alteration of the present duties on iron and steel, or for the grant of drawback in particular cases. In this matter we have, of course, a statutory responsibility not only to the iron and steel industry, but also to the innumerable industries in this country, consumers of iron and steel products, on whose prosperity the fortunes of the iron and steel industry so largely depend.

"After careful consideration of all the circumstances, bearing in mind the assurances which have from time to time been given to us by the industry and more particularly the terms of the resolutions passed by overwhelming majorities at the recent general meeting, we are satisfied that progress in the industry will be facilitated by removing the time limit to the present duties (October 25, 1934), and we recommend that such an order be made forthwith."

Plastic Moulding

(*Concluded from page* 349.)

was made of a properly heat-treated steel and was adequately looked after, it should not wear to any extent, and should produce at least 100,000 mouldings. With regard to the bakelite curb, the heat of the fire would only char the curb if it came in actual contact with the fire, but the radiant heat at a normal distance from the fire should not affect it.

Replying to Mr. Molineux, he agreed that the main competition seemed to be in the production of small electric fittings and furniture. Plastics were not suitable for resisting sliding wear, and they were also difficult to lubricate. Synthetic resins had been found to withstand the attack of all organic and inorganic solvents, with the exception of caustic. It was being used very successfully for battery boxes and would even withstand being boiled in acid.

Scrap as Filler Material

Referring to Mr. Hall's remarks, the scrap from the thermo-plastic materials could be reused, but with the Bakelite and Beatl products the properties, after curing, were completely altered, and his own opinion was that the scrap from these materials could only be ground to powder and used as a filler in place of wood flour, etc.

Replying to Mr. Tipper, plastics were definitely not porous, and the structure was believed to be amorphous. The material could be said to be completely impermeable to the passage of gases. It had no definite yield point and was like cast iron in this respect. A tensile strength of up to 20 tons could be obtained with the laminated materials made with sheets of linen, and with this material a yield point was obtained at about 12 tons per sq. in. The material did not exactly obey Hooke's law, and, strictly speaking, had no yield point. The pressure required in the production of the 17-in. square plate was 660 tons.

Sand-Lime Bricks

The British Standards Institution has issued a standard specification for sand-lime (calcium-silicate) bricks (B.S.S. No. 187-1934), which is a revision of B.S.S. No. 187 for sand-lime (calcium silicate) bricks. These bricks are made from a mixture of sand (silica) and lime heated under steam pressure which induces the formation of a thin layer of hydrated calcium silicate at the surface of the grains, thus cementing them together. The chief feature of the new specification is the inclusion of tests for the chemical composition of the brick. In the previous issue of the specification a permissive test for absorption was included in an appendix but further research appeared to indicate that the resistance of sand-lime bricks to frost action, the penetration of moisture through brick walls and the application and adhesion of mortar, plasters, and renderings to brick work were each affected in some degree by the size and structure of the pores of the bricks for which no simple and satisfactory test is yet available. The question of absorption is, therefore, left to be arranged between the purchaser and vendor. The strength of the standard brick has been substantially increased. Copies of this new specification may be obtained from the British Standards Institution, Publications Department, 28, Victoria Street, London, S.W.1. (Price 2s. 2d., post free.)

This Week's News in Brief

Trade Talk

BROOMHILL MALLEABLE HORSE SHOES, LIMITED, is being wound up voluntarily.

EXTENSIONS are being made to the factory of Tube Products, Limited, of Oldbury.

THE SOVIET STEAMER "Baikal" has arrived at Glasgow to load pipes and other steelwork for Leningrad.

THE CAPITAL of Messrs. Richard Johnson, Clapham & Morris, Limited, is to be reduced from £500,000 to £143,000.

THE MILLOM & ASKAM HEMATITE IRON COMPANY, LIMITED, is to light early in July a furnace for hematite pig-iron at the North Lonsdale Ironworks at Ulverston.

MESSRS. RHODES, BRYDON & YOUATT, LIMITED, Waterloo Engineering Works, Stockport, have been appointed sole agents and distributors in Great Britain for "Sihi" self-priming water pumps, vacuum pumps and compressors.

MR. JOHN PATERSON, of Bo'ness, was seriously injured whilst at work in the Bo'ness yard of a firm of shipbreakers. He was opening a cylinder containing ammonia, when it burst. The metal struck him and badly crushed his legs.

AMONG ORDERS placed by Arcos, Limited, for machinery and other equipment required for aircraft, railway and steelworks purposes in the U.S.S.R. is one placed with Messrs. Colvilles, Limited, Dalzell Works, for steel sections valued at £11,300.

OPERATIONS ARE PROCEEDING at present with the demolishing of a notable and extensive landmark at Stevenston Ayrshire-Ardeer Iron Works, formerly owned by Messrs. Merry & Cunninghame. The ironworks ground is adjacent to the I.C.I. factory.

BUILDERS' MERCHANTS throughout the country have received from the International Bath Association a letter giving them a few details of a new standardised bath. It is designed to save space, and will, with a lavatory basin, fit easily into a bathroom as small as 5 ft. by 4 ft. The bath uses less water, although its effective length is greater and it greatly reduces the splashing evil.

AN INCREASE in the wages of over 3,000 Scottish tube workers was agreed to at a conference in Glasgow this week between the Scottish Tube Makers' Wages Association, the Iron and Steel Trades Confederation, the Transport and General Workers' Union and the National Union of General and Municipal Workers. The minimum rate has been increased from 37s. to 41s. per week of 47 hours.

ARDROSSAN HARBOUR is busier than it has been for some years. Fully 150 men are working night and day unloading cargoes of scrap iron and iron ore, for which there is an abnormal demand. It is most unusual for scrap to be imported by Scotland, but owing to shortage, steel firms have been forced to buy foreign scrap. Ships fully laden had to lie at anchor, as all the unloading berths are occupied. This is the first time ships have been kept waiting for two years.

PREPARATIONS ARE BEING MADE for the fitting of the rudder to the new Cunarder, which will weigh 163 tons and measure 30 ft. by 15 ft. It will be the largest ever made in Great Britain, and will be so constructed as to have two doors to permit of workmen examining the interior and repairing any defect which might arise. Nearly all the riveting work is completed, but there is any amount of scope for ship joiners between now and the launching date in September.

THE SCOTTISH IRON AND STEEL PRODUCERS are to be allowed an increased production under the new quota scheme of the British Iron and Steel Trades Federation, which is organising production and marketing for the United Kingdom. Scottish iron producers will be allowed a quota of 1,000,000 tons a year, compared with the present estimated output of 440,000 tons a year. The million tons, however, is much below the record production of 1913. The steel producers will also be allowed a quota in excess of present production.

THE RECASTING of the bells of the ancient parish of Bishampton, near Pershore, is to be undertaken, and the belfry is to be repaired. The bells are a pre-Reformation Sanctus bell and a ring of six in the key of G, the tenor bell probably weighing between 10 cwts. and 11 cwts. The fifth bell was cast by Saunders in 1705, and the other five by Bagley in 1690. The peal is admired by campanologists, the tenor bell being particularly fine. None of the bells has been turned since first hung; consequently, they are badly worn at those places where the clappers have been striking for more than 200 years.

THERE IS A FEELING that the strike of moulders at the Grangemouth Iron Company's foundry at Falkirk will shortly come to an end, although a few days ago it appeared as though complete deadlock prevailed. The Ministry of Labour intervened and met in conference representatives of the employers and trade-union officials in an endeavour to arrive at a basis upon which the dispute could be brought to an end. The general secretary of the Ironfounding Workers' Association stated after the conference that he thought it would not be long before all the men were back at work. During the week a certain amount of liveliness has prevailed in the vicinity of the foundry, owing to a number of non-union men eluding the pickets and entering the foundry to give their services. When the men left at closing time they were subjected to an hostile demonstration by the strikers and sympathisers.

Company Reports

Glenfield & Kennedy, Limited. — Net profit, £29,851; brought in, £47,582; final dividend of 5 per cent. on ordinary shares, making 7 per cent.; carried forward, £49,745.

Park Gate Iron & Steel Company, Limited.—Gross profit, £81,962; brought in, £7,442; written off for depreciation, £35,000; dividend of 2 per cent., £29,062; to reserve fund, £10,000; carried forward, £15,342.

J. Stone & Company, Limited.—Trading profit and interest received, £19,279; transferred from contingency account and tax reserve, £45,000; balance after fees and depreciation, £11,365. After preference dividend, credit on profit and loss is reduced from £132,855 to £93,855.

Manganese Bronze & Brass Company, Limited.—Trading profit, including £2,300 previously reserved for tax but not now required, £12,435; net profit, after debenture interest, etc., and placing £3,500 to depreciation reserve, £460; brought in, £3,396; carried forward, £3,856.

Summerlee Iron Company, Limited.—Balance at credit of profit and loss account for the year to February 28 last of £28,855. The board recommend payment of arrears of the dividend on the preference shares at the rate of 4 per cent. per annum in respect of the two years ended February 28, 1933, and in addition the preference dividend for the year ended February 28 last will be duly met. During the year, under a capital reconstruction, the ordinary share capital was reduced by £888,750.

Contracts Open

Rochdale, June 2.—Cast-iron main pipes and specials, for the Town Council. The Engineer and Manager, Gasworks, Rochdale.

Argentina, June 18.—Centrifugal pumps and motors, for the Argentine State Oilfields. The Department of Overseas Trade. (Reference G.Y. 13,827.)

Reigate, June 13.—Supply and erection of pumping plant, for the Town Council. Messrs. G. B. Kershaw & Kaufman, chartered civil engineers, 9, Victoria Street, Westminster, S.W.1. (Fee £5, returnable.)

Rye Common, June 20.—Two electrically-driven vertical centrifugal well pumps and two sets of electrically-driven horizontal centrifugal high-lift pumps, piping, etc., for the Metropolitan Water Board. The offices of the Board, Chief Engineer's Department (Room 173), 173, Rosebery Avenue, E.C.1. (Fee £2 2s., returnable.)

Shipley, June 12.—Lead-covered and armoured cables, for the Urban District Council. Mr. H. Haigh, engineer and manager, Electricity Works, Dockfield, Shipley, Yorks.

South Africa, June 23.—Road rollers and steam wagon, for the City of Johannesburg. The Department of Overseas Trade. (Reference G.Y. 13,822.)

Thornham, June 5.—Motor-driven vertical borehole turbine pump, for the Doncaster Town Council. The Water Engineer's Department, 2, Priory Place, Doncaster. (Fee £2 2s., returnable.)

Personal

MR. HUGH BROWN, engineer to the Ardeer factory, Stevenston, has been made the recipient of a wireless set by the engineers' and blacksmiths' departments on his retirement after 40 years' service.

MR. J. PERCY PLANT has been elected chairman of the Board of Management of the Birmingham Section of the 1935 British Industries Fair, in succession to Mr. C. E. Greener.

MR. JAMES CUNNINGHAME, who has for many years been works manager of the Clydesdale Steel Works, Mossend, has been presented with a gold cigarette case by the members of the Bellshill Golf Club, of which he has been President for ten years, on the occasion of his being transferred to the works at Corby.

AN ENJOYABLE OUTING concluded the visit of Carron Company's outside representatives to Carron for a conference with the works staff last week-end, when, together with the managerial staff, a motor trip was taken through the Central Highlands. Before resuming the journey after lunch, at Pitlochry, a presentation of a gold-mounted walking-stick and similarly-mounted umbrella was made to Mr. George Pate, O.B.E., J.P., from the travelling staff. Mr. Robert B. Alexander, Manchester office, in making the presentation, said that he had been asked by the travelling staff to express to Mr. Pate their wishes and heartiest congratulations on the records he had achieved of forty years' service directly responsible to the directors, twenty-one of which he had been manager to the company.

Wills

RODGER, ROBERT, of J. M. Rodger & Sons, Kyle Foundry Ayr £4,131

PALMER, MAJOR G. M., chairman of the Chislet Colliery, Limited, the Marley Hill Chemical Company, Limited, and managing director of Messrs. John Bowes & Partners, Limited £54,473

Obituary

MR. ALEXANDER GEORGE HUDSON, works manager of the Middle Dock & Engineering Company, Limited, South Shields, since 1916, has died at South Shields. He started his career with the Stone Quay Boiler Works.

WHEN ABOUT TO FINISH WORK for the day in the moulding shop of Messrs. Jones & Campbell, Limited, Torwood Foundry, Larbert, Mr. Alexander Mackay, who resided in Denny, collapsed and died almost immediately. He was 54 years of age and had been employed in Torwood Foundry for over 35 years.

THE DEATH OCCURRED in a Glasgow nursing home of Mr. William Ford, who for many years was well known in shipbuilding and engineering circles on Clydeside. Mr. Ford, who was 65 years of age, had been employed with Messrs. John Brown & Company, Limited, Clydebank, for about 35 years as commercial manager and chief of the purchasing department.

MR. WILLIAM KIRKLAND, who died at his home in Kilmarnock, served an apprenticeship as a draughtsman with Messrs. Andrew Barclay & Company, Limited, and in 1887 entered the employment of Messrs. Glenfield & Kennedy Limited, in whose service he remained for 43 years, until he retired in 1930. For many years prior to his retirement Mr. Kirkland was travelling representative for Messrs. Glenfield & Kennedy, especially in connection with hydraulic work, regarding which he had specialised expert knowledge.

New Company

Charles Twigg & Company, Limited, Aldridge Works, Aldridge Road, Perry Barr, Birmingham.—Capital £15,000. Manufacturers of gas, electric, steam, oil and water fittings. Directors: C. H. Twigg, R. L. Heats, R. H. Edwards and H. E. Pullen.

Forthcoming Event

JUNE 5-8.

Institute of British Foundrymen.—Annual Conference in Manchester.

HIGH INTENSITY LIGHTING WITH LOWER RUNNING COSTS

"OSIRA"

REGISTERED TRADE MARK.

LAMPS

and

G.E.C. LIGHTING FITTINGS

MADE IN ENGLAND.

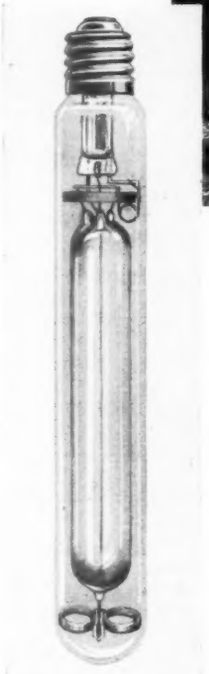
A Section of the foundry at Messrs. Ley's Malleable Castings, Ltd., Derby, showing illumination by "OSIRA" Lamps, and G.E.C. Dispersive Reflectors. Seventy more of these units are being installed.

This revolutionary system of lighting enables work to be carried out at night with the same facility as daylight.

The "OSIRA" Lamp operates without a filament, is run directly off A.C. mains with a stabilising choke, and gives 2½ times as much light as a tungsten lamp using the same amount of current.

By the use of "OSIRA" Lamps with appropriate G.E.C. Fittings, a remarkably high and even standard of illumination is obtained.

G.E.C. Engineers are at the Service of all interested in the application of Electric Lighting employing "OSIRA" Lamps and G.E.C. Lighting Fittings.



THE "OSIRA" LAMP
Covered by patents throughout the British Empire.

Advert. of The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.

Raw Material Markets

Activity is well maintained in the iron and steel trades, and it is encouraging to note that production was little affected by the Whitsun holiday, the break being cut down to the minimum in most cases. Generally speaking, the foundries remain fairly busy, the most satisfactory reports being received from the light-castings trade.

Pig-Iron

MIDDLESBROUGH.—Producers of Cleveland foundry iron are meeting with considerable pressure for supplies, and the entire output is readily disposed of. Business suffered little or no interruption over Whitsun, and contracts are now being negotiated over the third quarter. There is a sustained demand for Cleveland iron in Scotland and deliveries this month are unusually heavy, while local consumption is also on an improving scale. For home sales the controlled prices of No. 3 Cleveland G.M.B. pig-iron are 67s. 6d. per ton delivered Middlesbrough, 69s. 6d. delivered North-East Coast, 67s. 3d. delivered Falkirk and 70s. 3d. delivered Glasgow. Half-a-crown a ton premium is charged for No. 1 foundry iron and 1s. a ton discount is allowed on No. 4 foundry and No. 4 forge grades.

A good proportion of the output of East Coast hematite for several months ahead is already sold, but the makers could still absorb further orders. The home trade minimum price for No. 1 quality is maintained at 68s. per ton delivered Middlesbrough, graduated differences being applied for delivery to other areas.

LANCASHIRE.—Business is only just making a full recovery from the effects of the Whitsuntide stoppage, which were more pronounced in this area than in others. Conditions in the iron-consuming trades remain irregular, but continue to show signs of improvement in one or two directions. In the meantime, there is no alteration in the general price position to be reported. For delivery to users in the Lancashire zone, with the exception of Widnes, where the delivered rate is on the basis of 72s. 6d. per ton, Staffordshire, Derbyshire and North-East Coast brands of No. 3 foundry iron are all quoted at 74s., with Northamptonshire at 72s. 6d., Scottish foundry at about 82s. 6d., East Coast hematite at 76s. for No. 1 and 75s. for No. 3, both unbroken, and about 80s. 6d. for West Coast.

MIDLANDS.—The consumption of foundry iron in this area remains generally satisfactory. Not a great deal of new business has been about lately, however, as the majority of consumers are covered until the end of June, but a buying movement should set in shortly. The Association rates for local irons remain unchanged at 67s. 6d. per ton for Northants No. 3 and 71s. per ton for Derbyshire, Staffordshire and Lincolnshire No. 3, delivered to Birmingham and Black Country stations, and less rebate to large consumers. The demand for better grades of iron for engineering work, etc., is appreciating somewhat. Scottish iron is being quoted at between 85s. and 87s. 6d. per ton delivered Midland points, but other low-phosphorus irons are between 81s. and 85s. per ton, and medium-phosphorus grades 70s. to 80s. per ton. For Diesel-engine and similar work where refined iron is wanted, prices are between £5 15s. and £6 15s. per ton, according to tonnage and analysis.

SCOTLAND.—The demand for Scottish foundry iron has recently fallen away still further, and the market is very slow. There is no change to report in quotations, which are at the official minimum of 70s. per ton at furnaces for No. 3 foundry, with 2s. 6d. extra for No. 1. The light-castings makers remain busy, however, and are all working full time. No. 3 Cleveland is priced at 67s. 3d. at Falkirk and 70s. 3d. at Glasgow, other English pig-iron being offered at slightly less.

Coke

The foundry-coke market remains very firm. A number of contracts have recently been negotiated over the third quarter of the year, and further inquiries are circulating. Current quotations for delivery in the Birmingham district are as follow:—Best Durham coke, 36s. 6d. to 40s.; other grades, 2s. less; Scottish coke, 41s. to 42s.; Welsh coke, 37s. 6d. to 45s., according to quality and grade.

Steel

Rather quiet conditions continue to rule in the steel markets, but this is a seasonal feature, and in practically all departments of the industry the works are sufficiently well off for orders to be able to face the situation with confidence. The decision to continue the import duties has removed the uncertainty which was beginning to affect business, and it is anticipated that consumers will now show a greater inclination to enter into forward contracts. The demand for semi-finished steel has declined a little, although the works producing this class of material are busy on contracts which will keep them employed for some time. Competition in the home market from Continental sources has become more noticeable. In spite of the duty and the depreciation in sterling, quotations have been received at less than the British makers' figures. The finished-steel department of the market is active, and consumers are showing greater interest in forward business. Export trade, however, is difficult, although it is on a better scale than for some time past.

Scrap

The Cleveland scrap-iron market has developed a firmer tone, and 52s. 6d. and 55s. respectively are now minimum figures for heavy cast iron and machinery metal. There is more inquiry in this area for light metal, and 47s. 6d. is a firm quotation. Quotations are unchanged in the Midlands at 55s. for heavy machinery, 50s. for good heavy and 47s. 6d. for clean light metal, all delivered. The demand for scrap iron in South Wales is limited, but prices in that area remain fairly steady, light cast-iron scrap being the strongest section. Plentiful supplies of scrap iron are available in Scotland, and consumers experience little difficulty in picking up supplies at the current rates.

Metals

Copper.—Quotations have shown no definite trend in either direction this week, and the outlook remains uncertain. The restriction of trade with Germany has considerably affected European copper business, whilst the London market also continues to be disturbed by rumours from New York. The latest report from the United States regarding the copper "code" is that the surplus stocks of unsold copper (and, incidentally, lead and spelter) are to be purchased by the Government for use by the Army and Navy, and in public works. Whilst the world copper market would thus be relieved of a burden that has been troubling it for years, at the same time it must be remembered that such a step would entail the withdrawal from the American market of one of the largest sections of consumers.

Daily quotations:—

Cash.—Thursday, £32 6s. 3d. to £32 7s. 6d.; Friday, £32 13s. 9d. to £32 15s.; Monday, £32 10s. to £32 12s. 6d.; Tuesday, £32 15s. to £32 17s. 6d.; Wednesday, £32 10s. to £32 11s. 3d.

Three Months. — Thursday, £32 11s. 3d. to £32 12s. 6d.; Friday, £32 18s. 9d. to £33; Monday, £32 16s. 3d. to £32 17s. 6d.; Tuesday, £33 to £33 2s. 6d.; Wednesday, £32 16s. 3d. to £32 17s. 6d.

Tin.—The latest bulletin issued by The Hague Statistical Office of the International Tin Research and Development Council reveals a 29 per cent. increase in the world consumption of tin for the year ended March, 1934, as compared with the previous twelve months, the most notable increase taking place in the United States.

In their weekly report, Messrs. Brandeis, Goldschmidt & Company state that the premium on Straits tin, which at one time disappeared in London, has become slightly higher. It is reported that an international agreement is being negotiated between the tinplate industries in various countries, and no doubt some arrangement will be achieved later in this respect. In the meantime the higher prices which are being asked in this country for the finished product have not had a stimulating effect on sales. America has also been a less active buyer of tin, although it is difficult to estimate how far business is being affected by the code regulations in industry.

Market prices:—

Cash.—Thursday, £232 5s. to £232 10s.; Friday, £233 to £233 5s.; Monday, £233 15s. to £234; Tuesday, £234 to £234 5s.; Wednesday, £232 10s. to £232 15s.

Three Months.—Thursday, £228 5s. to £228 10s.; Friday, £229 10s. to £229 15s.; Monday, £229 15s. to £230; Tuesday, £230 5s. to £230 10s.; Wednesday, £229 15s. to £230.

Spelter.—Industrial requirements of this metal have recently slowed down, but this was largely due to a temporary closing of many works for the holiday. Supplies of Empire metal on the London market have not been very large lately, but this has been made up by heavier arrivals of Mexican zinc.

Day-by-day prices:—

Ordinary.—Thursday, £14 12s. 6d.; Friday, £14 15s.; Monday, £14 15s.; Tuesday, £14 15s.; Wednesday, £14 16s. 3d.

Lead.—Consumption of lead in this country is at quite a good level, but there is still a lack of business from the Continent, where trading is much interfered with by currency and other restrictions.

Market fluctuations:—

Soft Foreign (Prompt).—Thursday, £10 17s. 6d.; Friday, £11; Monday, £11 3s. 9d.; Tuesday, £11 2s. 6d.; Wednesday, £11 2s. 6d.

Fluxes in the Non-Ferrous Foundry

The use of fluxes for non-ferrous foundry practice has never been made a special subject or taken up on scientific lines until recently. Many remedies have been used, some with varying degrees of usefulness, the origin of which has probably been through guesswork, accident, etc., and handed down from generation to generation. Foundry Services, Limited, of 285, Long Acre, Nechells, Birmingham, 7, have been established for the manufacture and marketing of fluxes which have a definitely scientific background. The problems which they claim to have solved satisfactorily are difficulties associated with the presence of gases, oxide inclusions and impurities. As a case in point, it is well known that a small amount of aluminium in bronze will not only cause porosity, but the runners, risers and scrap are very difficult to remelt on account of the aluminium oxide. A flux has been specially made for overcoming this at but little expense to the user.

In the case of brass castings, apart from the question of porosity, the difficulty experienced with pitmarks when chromium plating has been overcome and the problems of oxidation in aluminium bronze, aluminium brass, etc., are quite easily resolved.

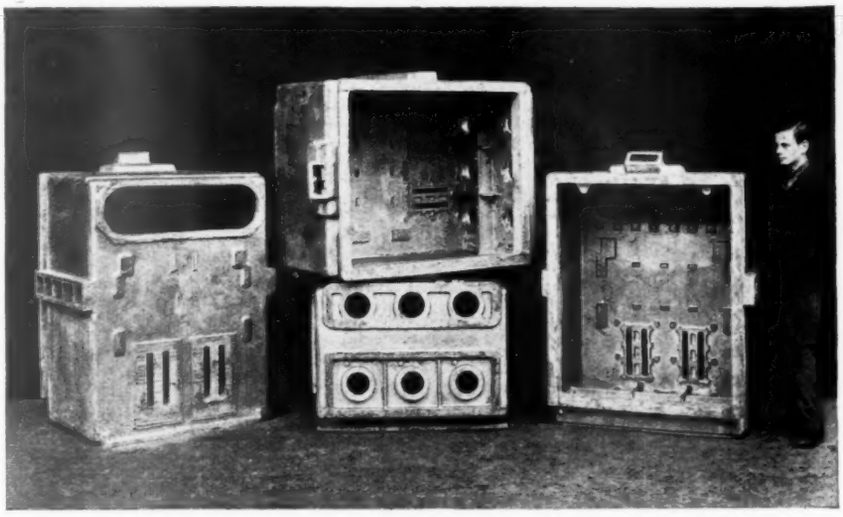
The elimination and prevention of gases and oxide in aluminium and its alloys have also been tackled. Aluminium oxide, being heavier than aluminium, can easily cause trouble because it becomes suspended in the metal and therefore cannot be eliminated with a surface flux. This is now overcome, with the result that castings can be produced to withstand porosity from reasonable scrap.

The tensile strength of aluminium alloys can be increased by 10 to 20 per cent. and elongation from 20 to 30 per cent., according to the alloy, through the intelligent application of fluxes. Again, with nickel alloys, the sulphur and carbon can be considerably reduced by a very simple and inexpensive method. These fluxes have come into existence through specialised attention by highly-qualified chemists whose work has been reinforced by metallurgical and practical experience.

Catalogue Received

Sand Bond. A leaflet received from Messrs. Colbond, 37, Golden Square, London, W.1, is particularly illuminating. It illustrates steel castings made by Kryn & Lahy, grey-iron castings by John Harper & Company, Limited, of Willenhall, and meehanite castings by Ealing Park Foundry, using Colbond as a sand bond. Yet we find the most interesting part is the section devoted to "How to Colbond," wherein mixtures are intelligently set out for giving various types of surface finishes to grey-iron castings. We advise our readers to write for this particular leaflet, which should carry, but does not, a reference number.

XUM



[Photo. by courtesy of Messrs. William Mills, Ltd.

ALUMINIUM AND LIGHT ALLOYS
The BRITISH ALUMINIUM CO. Ltd.
HEAD OFFICE: ADELAIDE HOUSE, KING WILLIAM ST., LONDON, E.C.4.
TELEPHONE: MANSION HOUSE 5561 & 8074 (5 LINES) TELEGRAMS: CRYOLITE, BILGATE, LONDON

for

NON-MAGNETIC CASTINGS

These switchgear conductor chambers weighing 3 cwts. each, are cast in "Wilmil" aluminium alloy. Whenever a non-magnetic metal is required, one or other of the light alloys of aluminium will often prove most suitable. They are cheaper than other available metals, especially when the parts are large. Castings will be rigid, sound, and free from porosity. Moreover, the metal has good casting and machining properties.

LONDON WAREHOUSE: 25-29, Pancras Rd., N.W.1. BIRMINGHAM: 2, Lawley St. MANCHESTER: 274, Deansgate. LEEDS: 66, Kirkstall Rd. NEWCASTLE-ON-TYNE: Milburn House. GLASGOW: 113, West Regent St.

The BRITISH ALUMINIUM COMPANY *Ltd.*

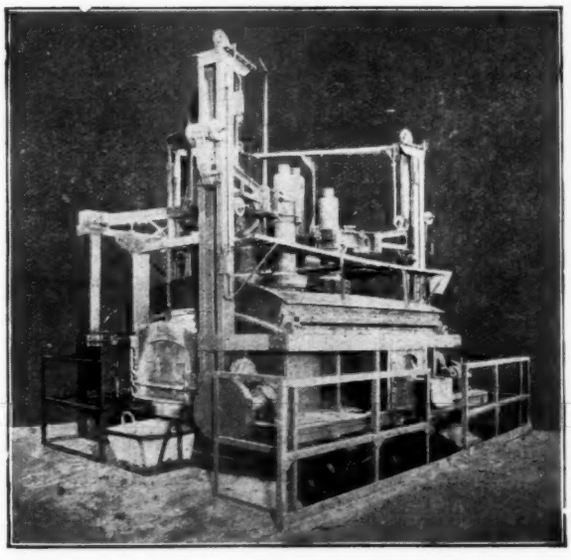
F.T.J. 31.5.34.

GREAVES-ETCHELLS ELECTRIC STEEL FURNACES

MORE THAN 100 FURNACES SUPPLIED DURING LAST 7 YEARS.

WATSON ROTATING ELECTRIC FURNACES Ensure RAPID & CLEAN MELTING

THOROUGH MIXING.



NON-FERROUS METAL MELTING ELECTRIC FURNACES

SINGLE, TWO, or THREE PHASE.

CONTRACTORS TO HOME AND FOREIGN GOVERNMENTS.

WATSONS (METALLURGISTS) LIMITED

Adelaide Works, Mowbray Street, SHEFFIELD, 3.

RAW MATERIALS—PRICE LIST

(Wednesday, May 30, 1934)

COPPER

	£	s.	d.
Standard cash	32	10	0
Three months	32	16	3
Electrolytic	36	0	0
Tough	34	15	0
Best selected	35	5	0
Sheets	62	0	0
India	44	5	0
Wire bars	35	15	0
Ingot bars	35	15	0
H.C. wire rods	38	10	0
Off. av. cash, April	33	10	10½
Do., 3 mths., April	33	5	8¼
Do., Sttlmnt., April	33	0	10½
Do., Electro, April	36	5	9
Do., B.S., April	36	3	1½
Do., wire bars, April	36	10	9
Solid drawn tubes			10d.
Brazed tubes			10d.
Wire			6½d.

BRASS

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8½d.
Rods, extd. or rlld.	4½d.
Sheets to 10 w.g.	7½d.
Wire	7½d.
Rolled metal	7d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5½d.
Do. 4 × 3 Sheets	5¼d.

TIN

	£	s.	d.
Standard cash	232	10	0
Three months	229	15	0
English	233	0	0
Bars	234	10	0
Straits (nom.)	233	0	0
Australian (nom.)			—
Eastern	230	5	0
Banca (nom.)			—
Off. av. cash, April	239	6	0
Do., 3 mths., April	237	13	8¼
Do., Sttlmt., April	239	6	3

SPELTER

	£	s.	d.
Ordinary	14	15	3
Remelted	14	17	6
Hard	12	5	0
Electro 99.9	17	7	6
English	15	10	0
India	14	5	0
Zinc dust	17	0	0
Zinc ashes	3	5	0
Off. aver., April	15	1	1¾
Aver. spot, April	14	18	3¾

LEAD

	£	s.	d.
Soft foreign ppt.	11	2	6
Empire	11	12	6
English	12	10	0
Off. average, April	11	12	11¼
Average spot, April	11	10	0

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	23	10	0
Do., V.M. ex whse.	22	17	6
Rods	28	15	0

ANTIMONY

	£	s.	d.	£	s.	d.
English	42	0	0	to 43	0	0
Chinese, ex-whse.				34	10	0
Crude				24	10	0

QUICKSILVER

	£	s.	d.	£	s.	d.
Quicksilver	10	17	6	to 11	5	0

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	£8 17 6
45/50%	£13 0 0
75%	£18 2 6
Ferro-vanadium—	
35 50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free of Mo.	5/6 per lb.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£14 10 0
Ferro-tungsten—	
80/85%	3/- lb.
Tungsten metal powder—	
98/99%	3/3 lb.
Ferro-chrome—	
2/4% car.	£32 0 0
4/6% car.	£23 0 0
6/8% car.	£21 12 6
8/10% car.	£21 12 6
Ferro-chrome—	
Max. 2% car.	£37 10 0
Max. 1% car.	£38 15 0
Max. 0.70% car.	£42 0 0
70% carbon-free	10½d. lb.
Nickel—99.5/100%	£200 to £205
"F" nickel shot	£180 0 0
Ferro-cobalt, 98/99%	5/3 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese—	
94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 1/16 in.	1/- lb.
Flats, ½ in. × ⅛ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ⅛ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

South Wales—	£	s.	d.	£	s.	d.
Heavy steel	2	13	6	to 2	15	0
Bundled steel and shrngs.	2	2	6	to 2	7	6
Mixed iron and steel				2	10	0
Heavy cast iron	2	7	0	to 2	8	0
Good machinery	2	10	0	to 2	12	6
Cleveland—						
Heavy steel				2	10	0
Steel turnings				1	17	6
Cast-iron borings				1	7	6
Heavy forge				2	10	0
W.I. piling scrap				2	5	0
Cast-iron scrap	2	12	6	to 2	15	0
Midlands—						
Light cast-iron scrap				2	7	6
Heavy wrought iron				3	0	0
Steel turnings, f.o.r.				1	13	0
Scotland—						
Heavy steel	2	10	0	to 2	11	3
Ordinary cast iron				2	13	6
Engineers' turnings				2	0	0
Cast-iron borings				2	0	0
Wrought-iron piling	2	10	0	to 2	11	3
Heavy machinery	2	15	0	to 2	16	0

London—Merchants' buying prices, delivered yard.

	£	s.	d.	£	s.	d.
Copper (clean)				27	0	0
Brass				19	10	0
Lead (less usual draft)				10	0	0
Tea lead				7	10	0
Zinc				9	10	0
New aluminium cuttings				70	0	0
Braziery copper				24	0	0
Gunmetal				25	0	0
Hollow pewter				155	0	0
Shaped black pewter				110	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	70/-
Foundry No. 3	67/6
,, at Falkirk	67/3
,, at Glasgow	70/3
Foundry No. 4	66/6
Forge No. 4	66/6
Hematite No. 1	68/-
Hematite M/Nos.	67/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	67/-
,, No. 3 fdry.	71/-
Northants forge	63/6
,, fdry. No. 3	67/6
,, fdry. No. 1	70/6
Derbyshire forge	67/-
,, fdry. No. 3	71/-
,, fdry. No. 1	74/-
Scotland—	
Foundry No. 1, f.o.t.	72/6
,, No. 3, f.o.t.	70/-
Hem. M/Nos. d/d	71/-
Sheffield (d/d district)—	
Derby forge	64/6
,, fdry. No. 3	68/6
Lincs forge	64/6
,, fdry. No. 3	68/6
E.C. hematite	80/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	74/-
Staffs fdry. No. 3	74/-
Northants fdry. No. 3	72/6
Cleveland fdry. No. 3	74/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	82/6
Clyde, No. 3	82/6
Monkland, No. 3	82/6
Summerlee, No. 3	82/6
Eglinton, No. 3	82/6
Gartsherrie, No. 3	82/6
Shotts, No. 3	82/6

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	9	12	6	to 9	15	0
Nut and bolt iron	7	5	0	to 8	0	0
Hoops	10	10	0	to 12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0	to 12	0	0
Bolts and nuts, ¾ in. × 4 in.				13	15	0
Steel—						
Plates, ship, etc.	8	15	0	to 8	17	6
Boiler plts.	8	2	6	to 8	10	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ½ in. (Untested)				8	12	0
Flats—8 in. wide and over				8	12	6
,, under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0	to 8	10	0
Fishplates	12	5	0	to 12	10	0
Hoops (Staffs)				—		
Black sheets, 24g. (4-t. lots)				10	10	0
Galv. cor. shts. (,,)				13	0	0
Galv. flat shts. (,,)				13	10	0
Galv. fencing wire, 8g. plain				14	10	0
Billets, soft				5	10	0
Billets, hard	6	17	6	to 7	2	6
Sheet bars	5	0	0	to 5	5	0
Tin bars				5	0	0

PHOSPHOR BRONZE

	Per lb. basis
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	12d.
Rods	11d.
Tubes	15d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	20.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	[illegible]
Basic, Valley	18.00
Bessemer	20.76
Malleable, Valley	18.50
Grey forge, Valley	17.50
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	29.00
Sheet bars	30.00
Wire rods	38.00
	Cents.
Iron bars, Phila.	1.94
Steel bars	1.90
Tank plates	1.85
Beams, etc.	1.85
Skelp, grooved steel	1.70
Steel hoops	2.10
Sheets, black, No. 24	2.65
Sheets, galv., No. 24	3.25
Wire nails	2.60
Plain wire	2.30
Barbed wire, galv.	3.00
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 30/-
,, furnace	20/-
Durham foundry	21/- to 25/-
,, furnace	17/6
Midlands, foundry	—
,, furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes 20×14 per box	17/3 to 17/6
,, 28×20 ,,	34/6 to 35/-
,, 20×10 ,,	24/9 to 25/-
,, 18⅞×14 ,,	18/- to 18/3
C.W. 20×14 ,,	15/6
,, 28×20 ,,	32/-
,, 20×10 ,,	22/- to 22/3
,, 18⅞×14 ,,	15/6 to 15/9

SWEDISH CHARCOAL IRON & STEEL

	£	s.	d.	£	s.	d.
Pig-iron	6	0	0	to £7	0	0
Bars-hammered, basis	£16	0	0	to £16	10	0
Bars and nail-rods, rolled, basis	£15	15	0	to £16	0	0
Blooms	£10	0	0	to £12	0	0
Keg steel	£30	0	0	to £31	0	0
Faggot steel	£18	0	0	to £23	0	0
Bars and rods dead soft, st'l	£10	0	0	to £12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£ s. d.	
May	24 ..	32 6 3	inc. 1/3
,,	25 ..	32 13 9	,, 7/6
,,	28 ..	32 10 0	dec. 3/9
,,	29 ..	32 15 0	inc. 5/–
,,	30 ..	32 10 0	dec. 5/–

Electrolytic Copper

		£ s. d.	
May	24 ..	35 5 0	No change
,,	25 ..	35 10 0	inc. 5/–
,,	28 ..	35 15 0	,, 5/–
,,	29 ..	36 0 0	,, 5/–
,,	30 ..	36 0 0	No change

Standard Tin (cash)

		£ s. d.	
May	24 ..	232 5 0	dec. 7/6
,,	25 ..	233 0 0	inc. 15/–
,,	28 ..	233 15 0	,, 15/–
,,	29 ..	234 0 0	,, 5/–
,,	30 ..	232 10 0	dec. 30/–

Tin (English ingots)

		£ s. d.	
May	24 ..	232 15 0	dec. 10/–
,,	25 ..	233 15 0	inc. 20/–
,,	28 ..	234 10 0	,, 15/–
,,	29 ..	234 10 0	No change
,,	30 ..	233 0 0	dec. 30/–

Spelter (ordinary)

		£ s. d.	
May	24 ..	14 12 6	inc. 2/6
,,	25 ..	14 15 0	,, 2/6
,,	28 ..	14 15 0	No change
,,	29 ..	14 15 0	,, ,,
,,	30 ..	14 16 3	inc. 1/3

Spelter (Electro, 99.9 per cent.)

		£ s. d.	
May	24 ..	17 3 9	dec. 1/3
,,	25 ..	17 5 0	inc. 1/3
,,	28 ..	17 5 0	No change
,,	29 ..	17 7 6	inc. 2/6
,,	30 ..	17 7 6	No change

Zinc Sheets (English)

		£ s. d.	
May	24 ..	23 10 0	No change
,,	25 ..	23 10 0	,, ,,
,,	28 ..	23 10 0	,, ,,
,,	29 ..	23 10 0	,, ,,
,,	30 ..	23 10 0	,, ,,

Lead (English)

		£ s. d.	
May	24 ..	12 5 0	No change
,,	25 ..	12 5 0	,, ,,
,,	28 ..	12 10 0	inc. 5/–
,,	29 ..	12 10 0	No change
,,	30 ..	12 10 0	,, ,,

AVERAGE MONTHLY PRICES OF IRON HOOPS.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year's average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1898	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	7 0 0	6 11 6
1899	7 0 0	7 0 0	7 0 0	7 0 0	7 12 6	10 12 6	8 12 6	8 12 6	8 12 6	9 2 6	9 7 6	9 17 6	8 2 9
1900	9 17 6	10 7 6	10 7 6	10 7 0	10 12 6	7 12 6	10 12 6	10 12 6	10 12 6	9 17 6	9 2 6	9 2 6	10 3 8
1901	9 2 6	8 2 6	8 2 6	7 12 6	7 12 6	7 12 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 11 2
1902	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1903	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 0
1904	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1905	6 17 6	7 0 0	7 0 0	7 0 6	7 0 0	7 0 0	7 2 6	7 2 6	7 2 6	7 7 6	7 0 0	7 7 6	7 2 0½
1906	7 10 0	7 17 6	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	8 7 6	7 15 1½
1907	8 7 6	8 7 6	8 7 6	8 7 0	8 7 6	8 7 6	8 10 0	8 10 0	8 10 0	8 5 0	8 5 0	8 0 0	8 7 1
1908	8 0 0	7 10 0	7 10 0	7 10 6	7 10 0	7 10 0	7 10 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 6 8
1909	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0
1910	7 1 10½	7 6 3	7 7 6	7 7 0	7 7 6	7 7 6	7 7 6	7 7 6	7 7 6	7 6 3	7 5 0	7 5 0	7 6 5
1911	7 5 0	7 5 0	7 5 0	7 5 6	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 8 9	7 10 0	7 10 0	7 6 2½
1912	7 12 6	7 12 6	7 12 6	7 15 0	7 15 0	8 2 6	8 2 6	8 2 6	8 12 6	8 12 6	8 12 6	8 15 0	8 2 3½
1913	8 17 6	8 17 6	8 17 6	8 17 0	8 17 6	8 17 6	8 17 6	8 17 6	8 7 6	8 7 6	8 7 6	7 17 6	8 12 6
1914	7 17 6	7 17 6	7 17 6	7 13 9	7 12 6	7 12 6	7 12 6	9 2 6	9 2 6	9 2 6	9 2 6	9 2 6	8 6 4½
1915	9 3 6	9 18 1	10 7 6	10 16 6	10 17 6	13 2 6	13 2 6	13 2 6	13 7 6	14 2 6	15 2 6	15 18 6	12 10 1
1916	17 2 6	17 2 6	17 2 6	17 6 3	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 6 1
1917	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6
1918	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6
1919	17 2 6	17 2 6	17 2 6	17 2 6	24 6 3	24 6 3	24 6 3	25 9 0	26 7 6	26 7 6	26 7 6	26 17 4	22 14 9
1920	28 0 0	28 12 6	33 15 0	35 5 0	35 15 10	38 17 6	38 17 6	38 17 6	38 17 6	38 17 6	36 17 6	36 17 6	35 14 9
1921	29 1 3	23 5 0	21 12 6	20 0 0	20 0 0	20 0 0	17 5 0	15 0 0	14 4 0	13 15 0	13 10 0	12 18 0	17 5 10
1922	16 5 0	15 13 9	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	13 4 6½
1923	14 0 0	15 0 0	15 0 0	15 0 0	15 6 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	14 16 0	14 15 0	14 18 3½
1924	14 15 0	14 15 0	14 15 0	14 15 0	14 15 0	14 13 9	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 12 4½
19[illegible]	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0
192[illegible]	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0
1927	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	12 10 0	12 10 0	14 3 4
1928	12 10 0	12 7 6	12 0 0	11 13 6	11 15 0	11 12 6	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 14 10½
1929	11 10 0	11 10 0	11 10 0	11 10 0	11 9 0	11 5 0	11 5 0	11 5 0	11 5 0	11 2 0	11 0 0	11 0 0	11 5 11
1930	11 0 0	11 0 0	11 0 0	10 16 3	10 15 0	10 15 0	10 15 0	10 15 0	10 15 0	10 15 0	10 15 0	10 15 0	10 16 4½
1931	10 15 0	10 [illegible] 0	10 15 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 11 3
1932	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0
1933	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0
1934	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	—	—	—	—	—	—	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

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REGISTERED TRADE MARK

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All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

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COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

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ZETLAND ROAD, MIDDLESBROUGH.

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

ROLL Foundry Manager (life experience), possessing full technical and practical qualifications, is now at liberty.—Full particulars will be sent on application to Box 768, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

CHILLED ROLLS. — Foundry Manager of proved experience wanted for important Italian works. Contract 1/2 years.—Full particulars in confidence to Box 463, c/o JUDDS, 47, Gresham Street, London, E.C.2.

IRONFOUNDRY requires Foreman who can also introduce dozen Floor Moulders used to general engineering work, to work under his control.—Apply, Box 772, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

EXPERIENCED Foundry Foreman desires position. General engineering, jobbing, machine-moulding. Experienced in estimating, cupola practice, etc. (245)

YOUNG Foundry Foreman in charge of grey-iron, non-ferrous, malleable foundry, desires change. Willing to go abroad. (246)

BUSINESS FOR SALE

OLD-ESTABLISHED Ironfoundry for Sale owing to death; going concern, well connected, full up with orders; competent staff, good buildings; freehold, 1¼ acres.—Box 770, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PROPERTY

MAGNIFICENT

11 ACRES WORKS SITE.

SHEFFIELD.

145,000 Sq. Ft. of Shops.

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with L.M. & S. and L. & N.E. Rlys.

WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—

THOS. W. WARD, LTD.,

ALBION WORKS, SHEFFIELD

MACHINERY

ONE genuine Tabor Roll-over Shockless Jolt-ram MOULDING MACHINE to take 30-in. by 40-in. boxes; practically new; can be seen working. Price £120.

One Roll-over Shockless Tabor JOLTING MACHINE to take 60 in. x 48 in.; can be seen working. Price £160.

A. HAMMOND, 14, Australia Road, Slough.

SAND-BLAST PLANTS AND AIR COMPRESSORS

(Tilghman's).

We have in stock :—

11 NEW SAND-BLAST PLANTS.
14 Re-conditioned Sand-blast Plants.
90 NEW AIR COMPRESSORS.
15 Re-conditioned Air Compressors.
All sizes—all pressures.

Sand-blasting and Metal-spraying for all Trades.

R. J. RICHARDSON & SONS, LTD.,
COMMERCIAL STREET, BIRMINGHAM, 1.

SANDBLAST PLANTS

Room, Rotary Barrel and Cabinet Types complete; 12 in stock.

SAND PLANT

Sand Mills, 6-ft., 5-ft. and 4-ft. 6-in. dia. Pans.
Rotoil "Senior" Oil Core Sand Mixer.
Pneulec Sand Drying Plant, output 1 ton per hour.
Brearley Type Disintegrators.

MOULDING MACHINES

Hand and Pneumatic Types.
Also
Six Rowlands Double-ended Grinders for 24-in. dia. x 2-in. wheels.
Electrical and Belt-driven Blowers and Exhaust Fans, Ladles, etc., etc.

AIR COMPRESSORS

All sizes for high and low pressures.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

THOS. W. WARD LTD.

Hori. Treble Ram PUMP (Worthington), 8" dia. rams, 12" str.
13" cen. S.S. and Sc. LATHE, 10' 0" bed, 2½" hollow spin.
Set of Motor-dr. PLATE SHEARS, blades 4' 6" long.
2 BABCOCK W.T. BOILERS, 160 lbs. w.p., 5,540 sq. ft. heating surface.
4 LANCS BOILERS, 30' x 8', 200 lbs. w.p.

Write for "Albion" Catalogue.

'Grams: "Forward." 'Phone: 23001 (10 lines).

ALBION WORKS, SHEFFIELD.

MISCELLANEOUS

FLUIDITY TESTS as described in THE FOUNDRY TRADE JOURNAL, February 1, 1934. Patterns of the above in aluminium can be supplied for 35s. per set. Post free. We can also supply Patterns for all branches of the engineering trade, in hard or soft woods. Send us your inquiries.—FURMSTON & LAWLOR, Patternmakers, Letchworth, Herts.

STEEL SCRAP, consists of melted-down safety-razor blades; about 50 tons for quick sale.—J. C. MACKINLAY & COMPANY, 27, Walbrook, London, E.C.

CORE BOXES, dowelled and varnished, ready for use, made to order in all lengths and variety on shortest notice. HARDWOOD MALLETS also a speciality.—WILLIAM OLSEN, LIMITED, Cogan Street, Hull.

MISCELLANEOUS—*Continued*

TIME RECORDERS (workpeople); guaranteed; must clear.—Box 734, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

'Phone: 287 SLOUGH

SANDBLAST PLANTS

12' × 9' Tilghman sandblast room, built of cast iron plates, complete with 400 cu. ft. Tilghman air compressor and all accessories **£290 Nett.**

T.B. 1 Tilghman sandblast barrel plant, complete. CHEAP.

T.B. 3 Tilghman sandblast barrel plant, double-jet, complete. CHEAP.

6' "Jackman" rotary sandblast table. CHEAP seen working.

SAND PLANT

Herbert "Whizzer" type disintegrator, No. 1 **£30**
Pneumatic riddle, by Macdonald **£8**
Large "Baillott" sand preparing plant CHEAP.

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun and on occasions—be it admitted—of naughtiness.

Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception.

Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed.

There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d. a year to you. Send Peter and his handicapped pals 3d. for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,

SCHOOL FOR THE BLIND

(Founded 1838),

SWISS COTTAGE, LONDON, N.W.3.